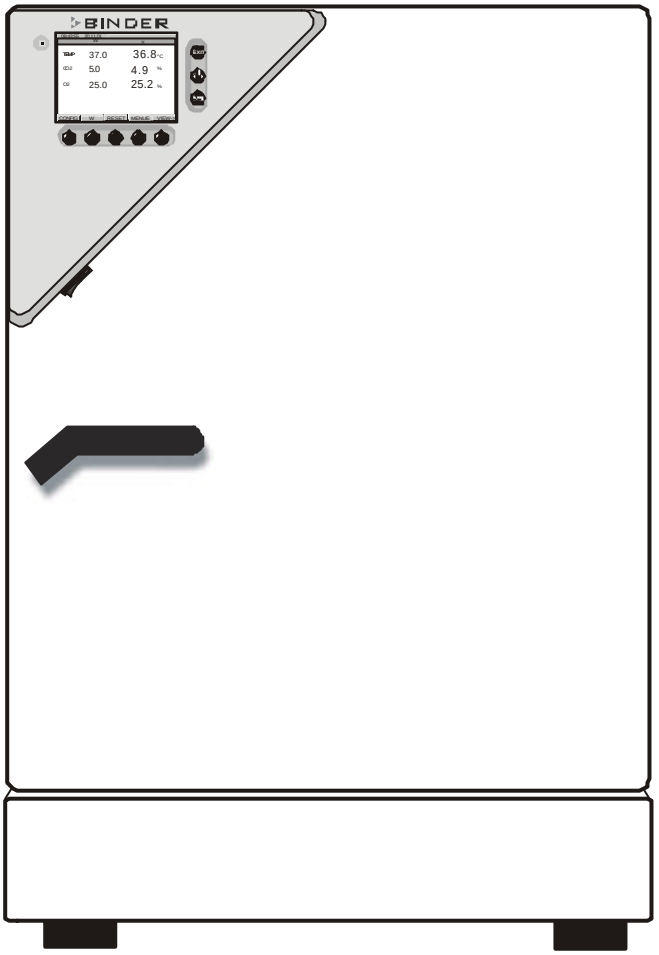
CB (E2) Service Manual



Version of the described Chamber :

Standard equipped CB CO_2 Incubator E2
with
FPI Sensor System
and
MB1 Controller

SERIAL-NO. 01-27954 →
Order-No. 9040-0012 / CB 150
Order-No. 9040-0013 / CB 210

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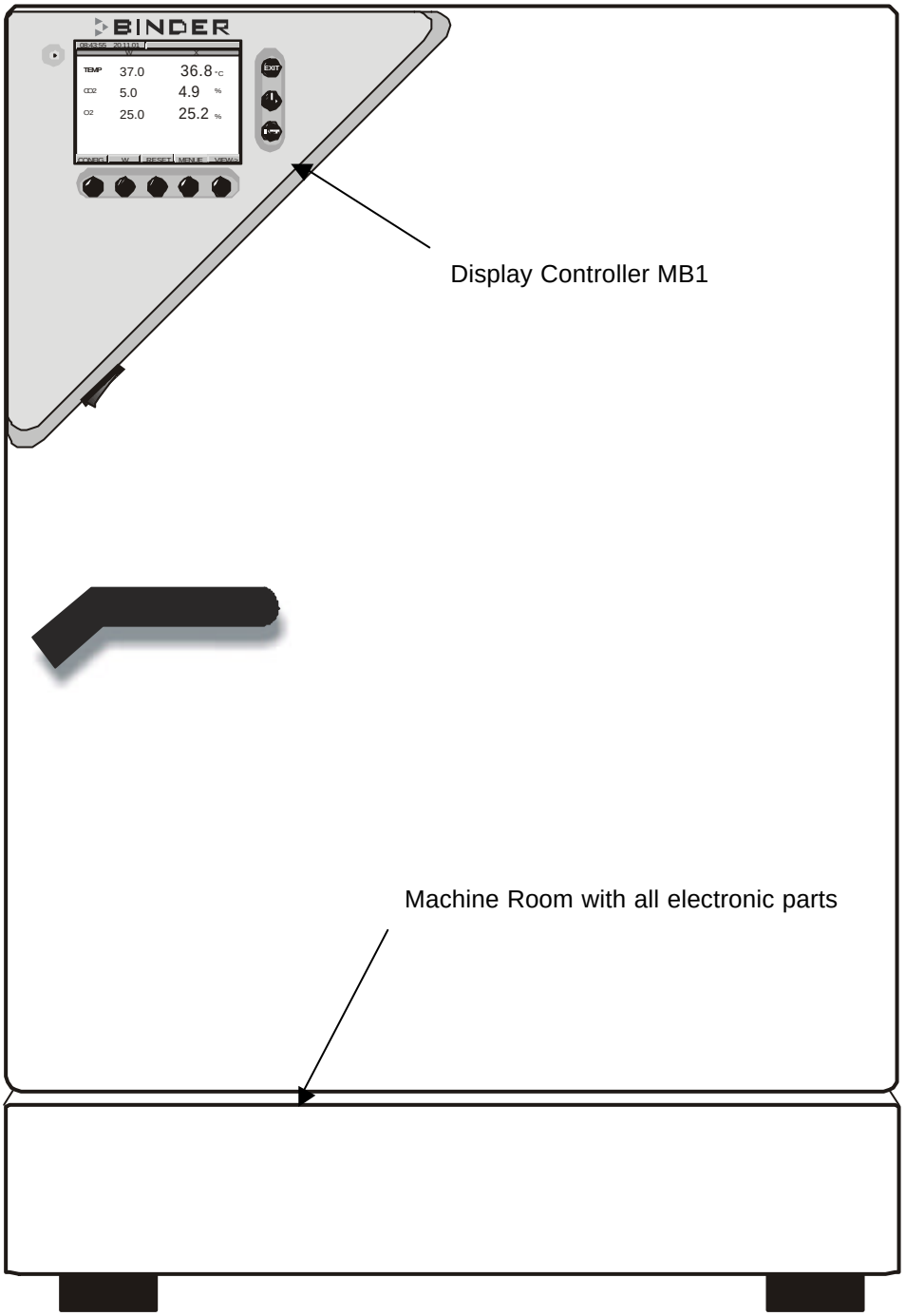
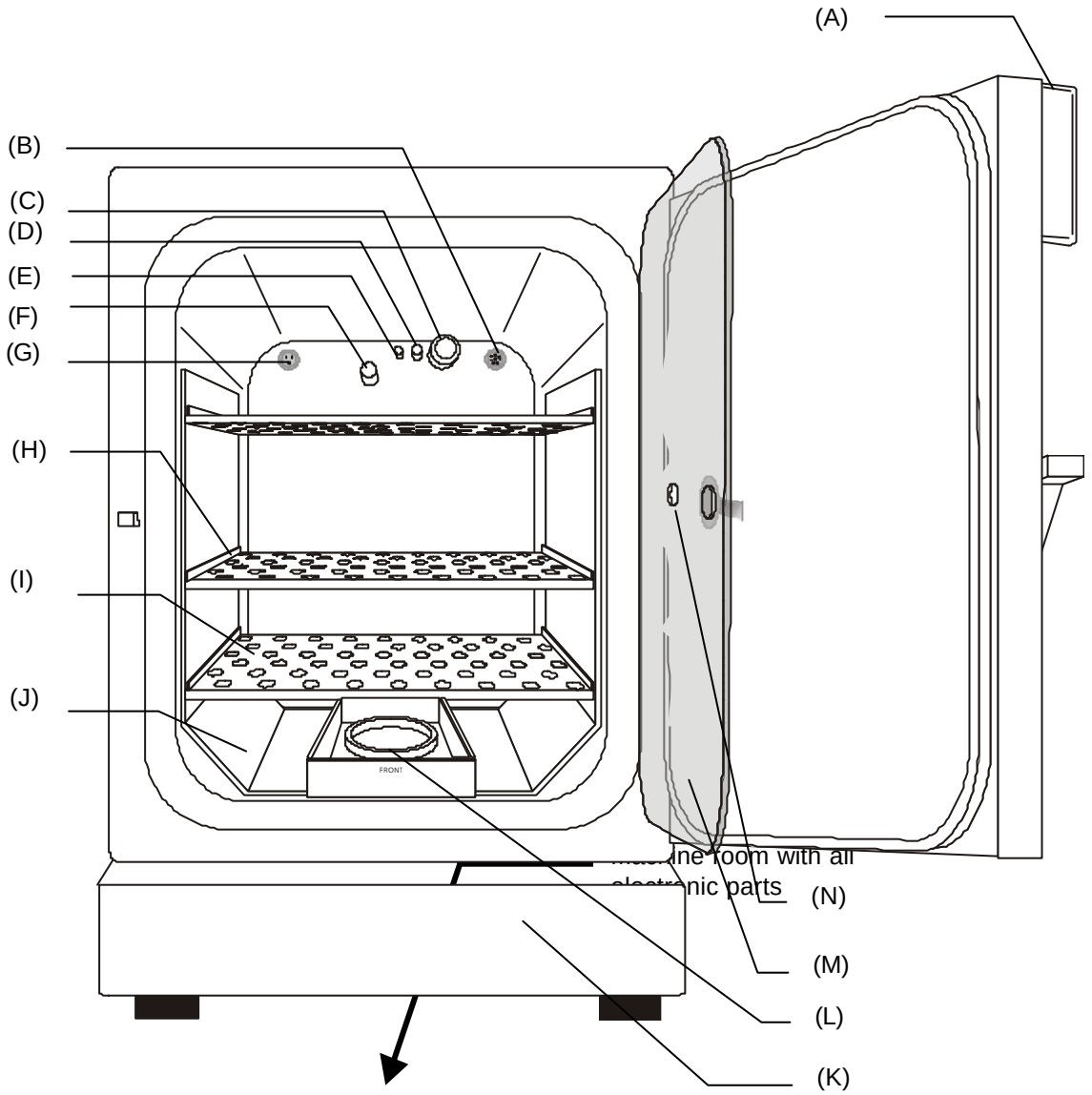
1 Modification levels

The CB CO_2 Incubator E2 is a further development of CB CO_2 Incubator E1. Especially the Display controller MB1 inside the red triangle is conspicuous.
The whole electronic is placed inside the lower part of the CB CO_2 Incubator (Front Access Maintenance). Theres no I-box as at the CB CO_2 Incubator E1 at the top of the chamber.



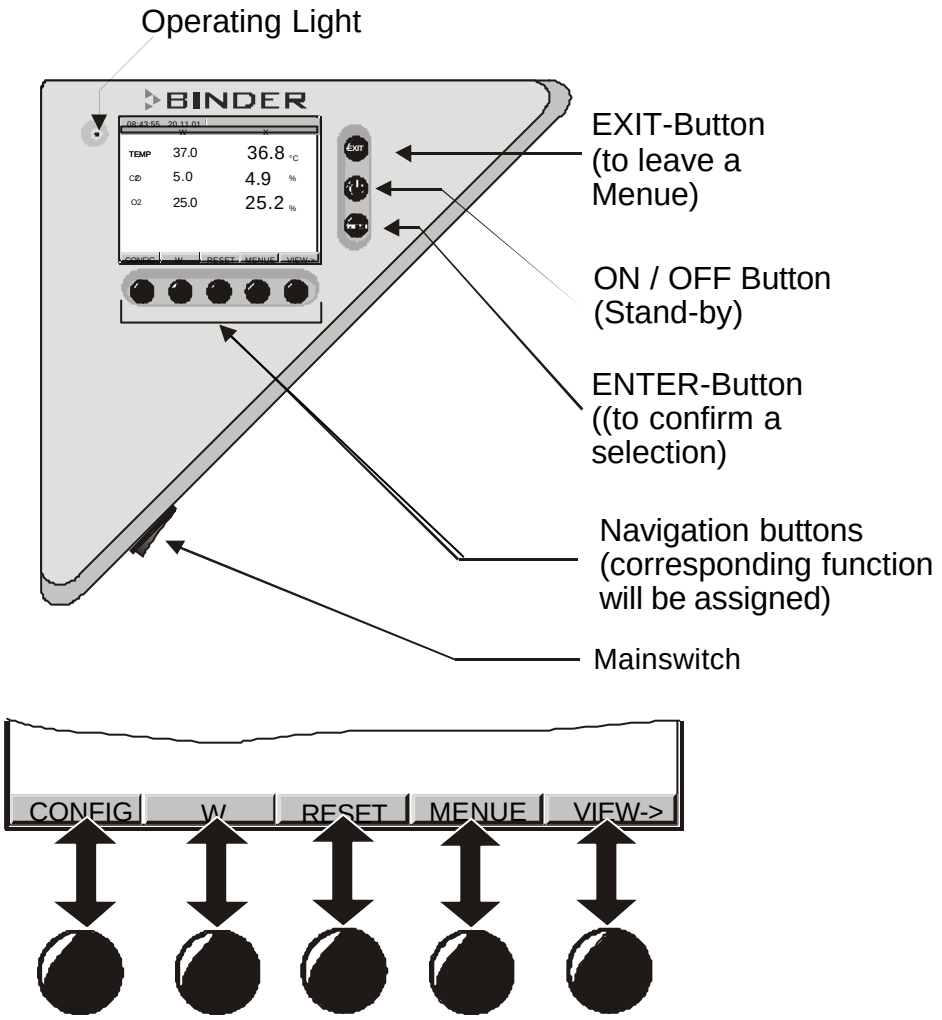
2 Unit overview



A) Display controller MB1 for temperature and CO_2 as well as O_2 (option)
B) Connection socket for low tension supply (option)
C) CO_2 sensor
D) Gas mixing head
E) PT 100 temperature probe
F) O_2 sensor (option)
G) Internal socket 230V (max. 3 A) (option)
H) Shelf holder bar
I) Shelves
J) Shelf holder
K) Lower housing cover
L) Permadry® water basins
M) Inner glass door
N) Measuring access port

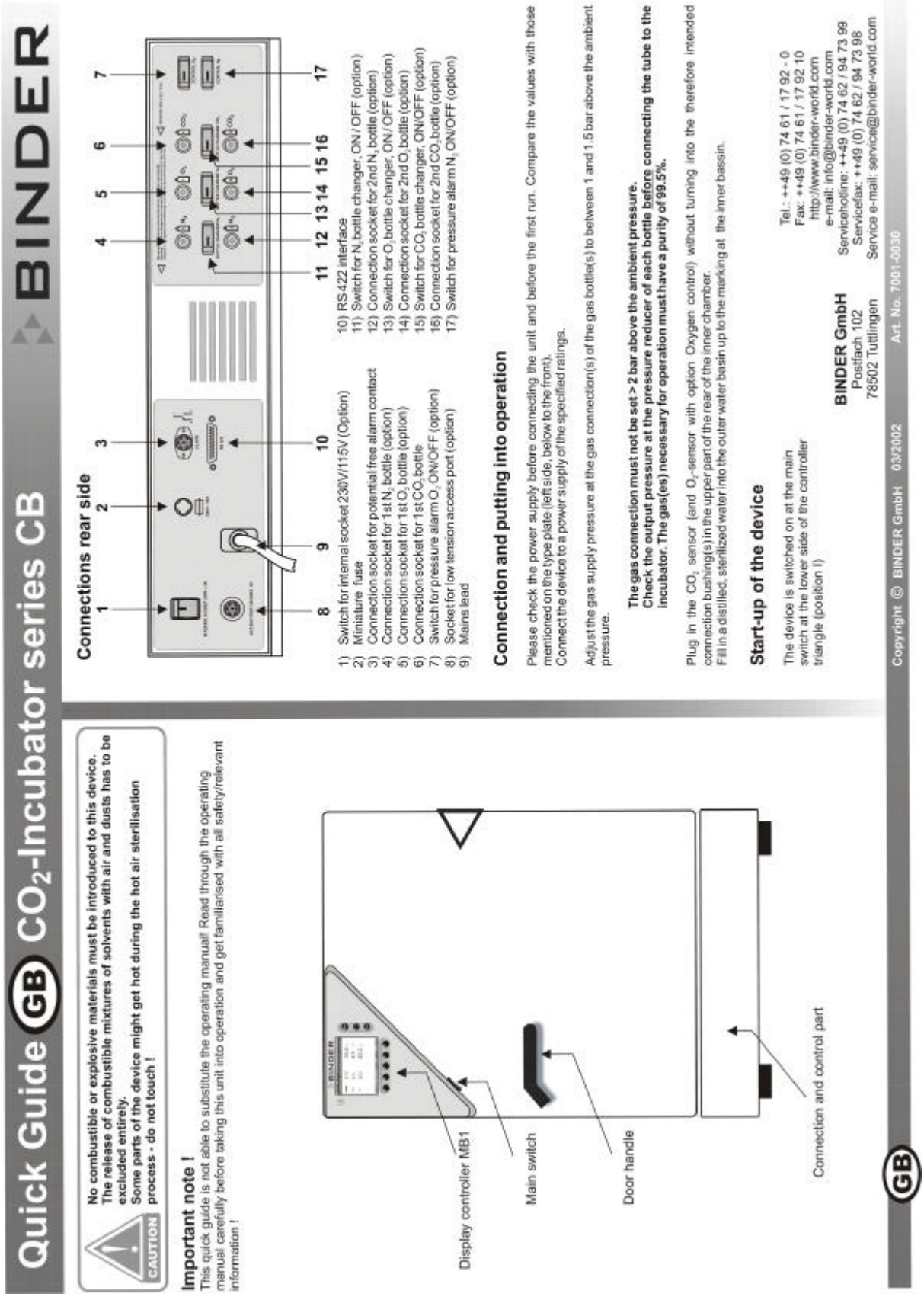
2.1 The Controller MB1

Display Controller MB1



For the controller MB1, it is possible to show all setpoints and actual values at the same time. It is also possible to display the actual values portrary.

2.2 Short description of the MB1 Controller


Quick Guide GB CO2-Incubator series CB
BINDER
CAUTION
No combustible or explosive materials must be introduced to this device.
The release of combustible mixtures of solvents with air and dusts has to be excluded entirely.
Some parts of the device might get hot during the hot air sterilisation process - do not touch !
Important note !
This quick guide is not able to substitute the operating manual! Read through the operating manual carefully before taking this unit into operation and get familiarised with all safety/relevant information !
Connections rear side
1) Switch for internal socket 230V/115V (Option)
2) Miniature fuse
3) Connection socket for potential free alarm contact
4) Connection socket for 1st N2 bottle (option)
5) Connection socket for 1st O2 bottle (option)
6) Connection socket for 1st CO2 bottle
7) Switch for pressure alarm O2 ON/OFF (option)
8) Socket for low tension access port (option)
9) Mains lead
10) RS 422 interface
11) Switch for N2 bottle changer, ON / OFF (option)
12) Connection socket for 2nd N2 bottle (option)
13) Switch for O2 bottle changer, ON / OFF (option)
14) Connection socket for 2nd O2 bottle (option)
15) Switch for CO2 bottle changer, ON/OFF (option)
16) Connection socket for 2nd CO2 bottle (option)
17) Switch for pressure alarm N2 ON/OFF (option)
Connection and putting into operation
Please check the power supply before connecting the unit and before the first run. Compare the values with those mentioned on the type plate (left side, below to the front).
Connect the device to a power supply of the specified ratings.
Adjust the gas supply pressure at the gas connection(s) of the gas bottle(s) to between 1 and 1.5 bar above the ambient pressure.
The gas connection must not be set > 2 bar above the ambient pressure.
Check the output pressure at the pressure reducer of each bottle before connecting the tube to the incubator. The gas(es) necessary for operation must have a purity of 99.5%.
Plug in the CO2 sensor (and O2-sensor with option Oxygen control) without turning into the therefore intended connection bushing(s) in the upper part of the rear of the inner chamber.
Fill in a distilled, sterilized water into the outer water basin up to the marking at the inner bassin.
Start-up of the device
The device is switched on at the main switch at the lower side of the controller triangle (position I).
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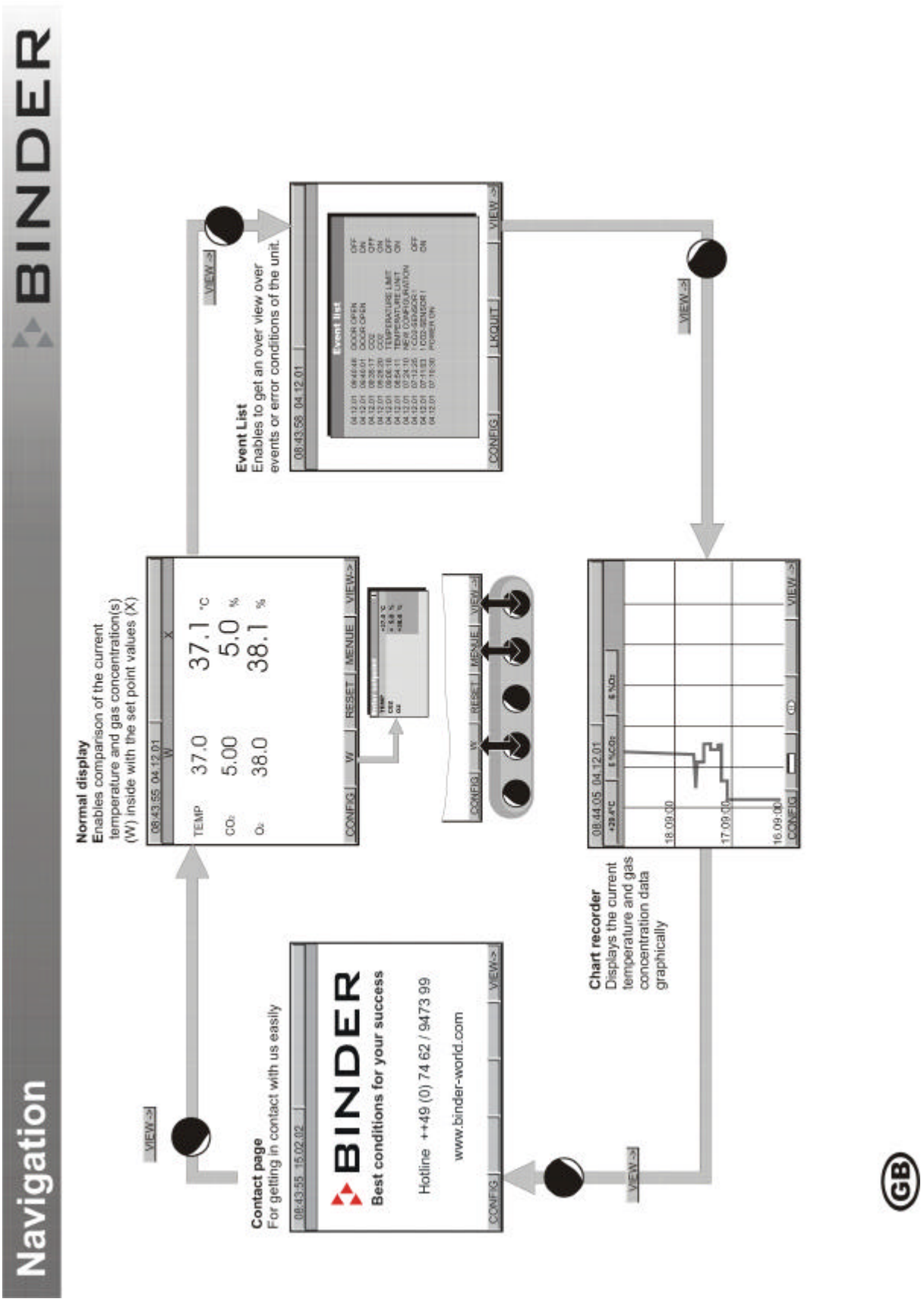
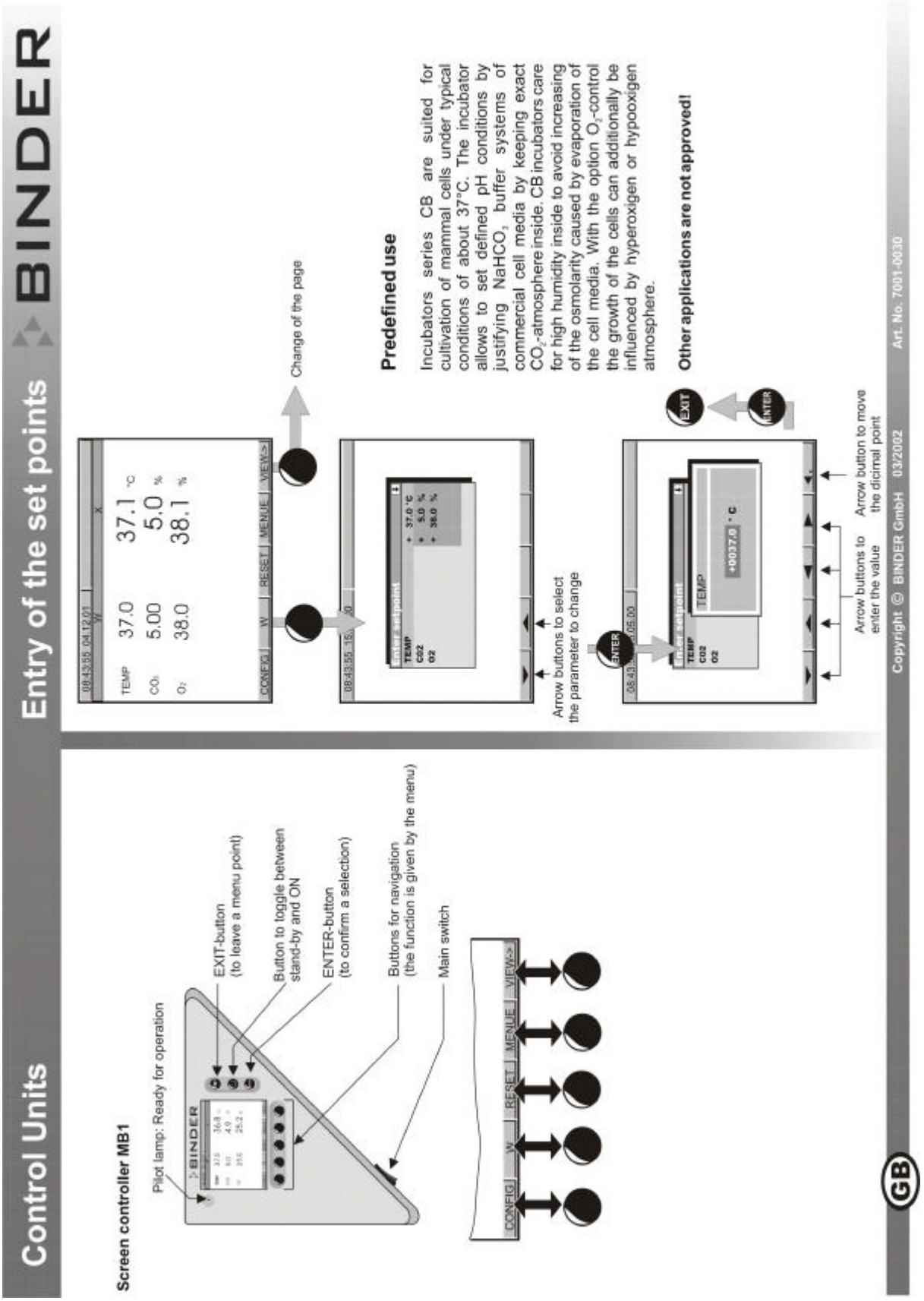
Display controller MB1
Main switch
Door handle
Connection and control part


Navigation
BINDER
Normal display
Enables comparison of the current temperature and gas concentration(s) (W) inside with the set point values (X)
Event List
Enables to get an over view over events or error conditions of the unit.
Chart recorder
Displays the current temperature and gas concentration data graphically
Contact page
For getting in contact with us easily
Best conditions for your success
Hotline ++49 (0) 74 62 / 9473 99
www.binder-world.com
VIEW->
CONFIG
RESET
MENUE
GB


Control Units
Entry of the set points
BINDER
Screen controller MB1
Pilot lamp: Ready for operation
EXIT-button
(to leave a menu point)
Button to toggle between
stand-by and ON
ENTER-button
(to confirm a selection)
Buttons for navigation
(the function is given by the menu)
Main switch
CONFIG
W
RESET
MENUE
VIEW->
Change of the page
Predefined use
Incubators series CB are suited for cultivation of mammal cells under typical conditions of about 37°C. The incubator allows to set defined pH conditions by justifying $NaHCO_3$ buffer systems of commercial cell media by keeping exact CO_2-atmosphere inside. CB incubators care for high humidity inside to avoid increasing of the osmolarity caused by evaporation of the cell media. With the option O_2-control the growth of the cells can additionally be influenced by hyperoxigen or hypooxigen atmosphere.
Other applications are not approved!
Arrow buttons to select
the parameter to change
Arrow buttons to
enter the value
Arrow button to move
the dicimal point
ENTER
EXIT
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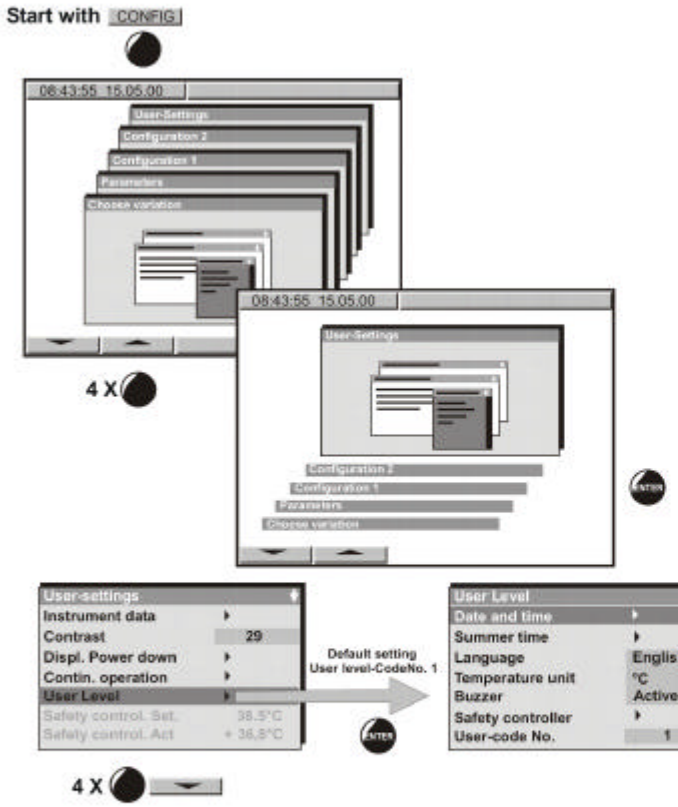
Individual controller settings

BINDER



Setting of the over temperature protection

This unit is equipped with an over temperature safety device class 3.1 acc. to the standard DIN 12880. It is carried out as a second, electrically independent temperature controller that overtakes the control function at a selectable set point in case of a faulty condition. This controller is called "safety controller". It serves to protect the charging material from extensive high temperatures.
In case the safety controller gets active, this state is indicated on the controller display by the message "TEMPERATURE LIMIT". The device is controlled by the safety controller at its entered set point, as long as the temperature inside the chamber returns under the maximum temperature and the user resets the controller by pressing the button Reset

The entry of the set point type divides into ...

Limit:
Absolute max. permitted temperature value (for the most common set point 37°C the limit is e.g. 38.5°C)

Offset:
Maximum over temperature above any active temperature set point. (A common value is 1.5°C)

The limit or the offset are entered in the field "Setpoint".

The setting of the unit as set on the user Level under "Temperature unit" is valid.
In case of changing this unit later on, the entered value gets not automatically corrected!

Individual user setting can be entered within this menu. The settings remain in memory also after power-off.
The texts of the menu can be displayed in German, English and French language. The menu has to be left for a short while after having changed the language to enable the new setting.

Any changed user level code must be taken carefully in mind.

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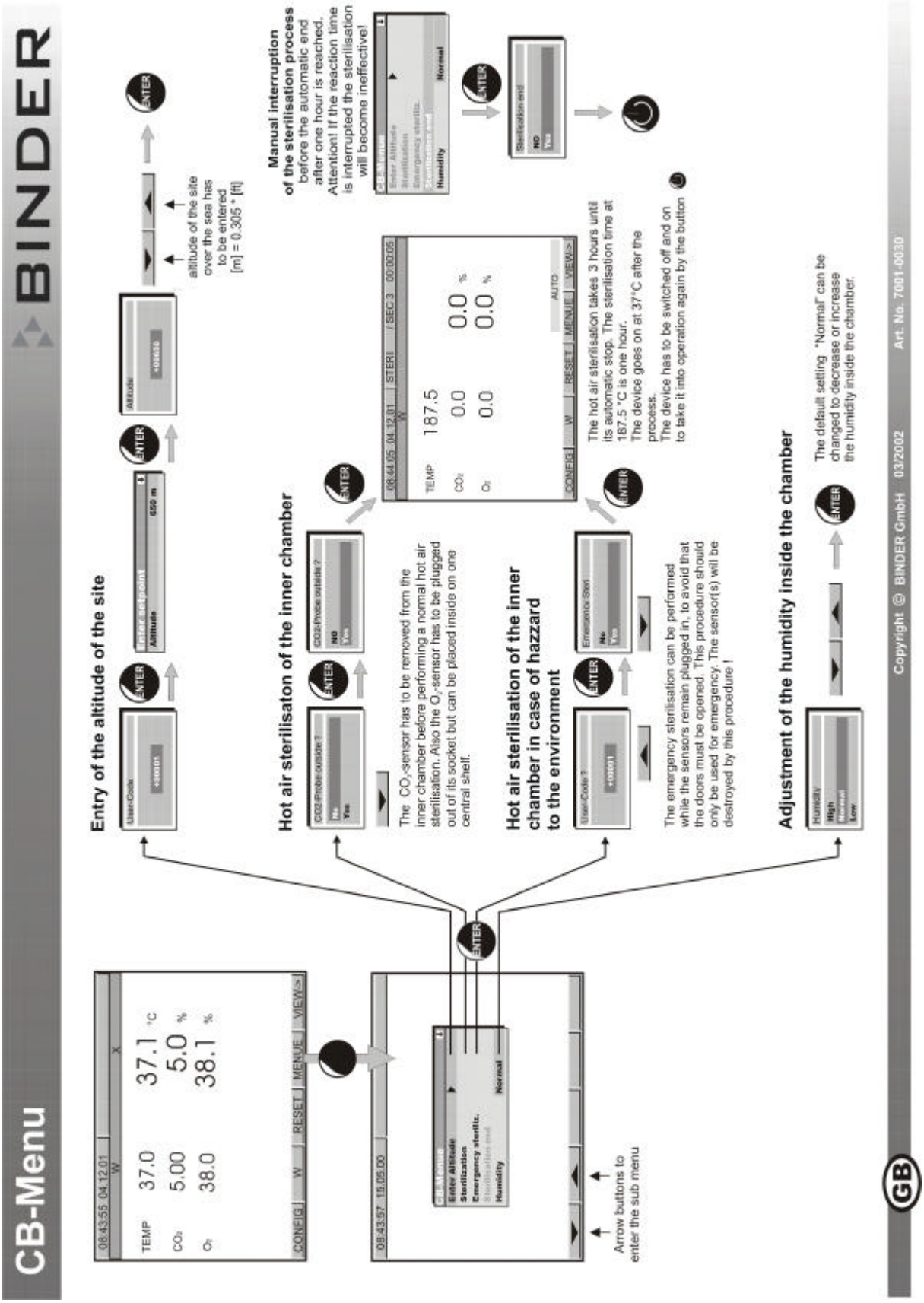
CB-Menu
BINDER
Entry of the altitude of the site
Hot air sterilisaton of the inner chamber
Hot air sterilisation of the inner chamber in case of hazzard to the environment
Adjustment of the humidity inside the chamber
Manual interruption of the sterilisation process
before the automatic end after one hour is reached.
Attention! If the reaction time is interrupted the sterilisation will become ineffective!
altitude of the site over the sea has to be entered [m] = 0.305 * [ft]
The CO2-sensor has to be removed from the inner chamber before performing a normal hot air sterilisation. Also the O2-sensor has to be plugged out of its socket but can be placed inside on one central shelf.
The hot air sterilisation takes 3 hours until its automatic stop. The sterilisation time at 187.5 °C is one hour.
The device goes on at 37°C after the process.
The device has to be switched off and on to take it into operation again by the button
The emergency sterilisation can be performed while the sensors remain plugged in, to avoid that the doors must be opened. This procedure should only be used for emergency. The sensor(s) will be destroyed by this procedure !
The default setting "Normal" can be changed to decrease or increase the humidity inside the chamber.
Arrow buttons to enter the sub menu
ENTER
CONFIG
W
RESET
MENUE
VIEW
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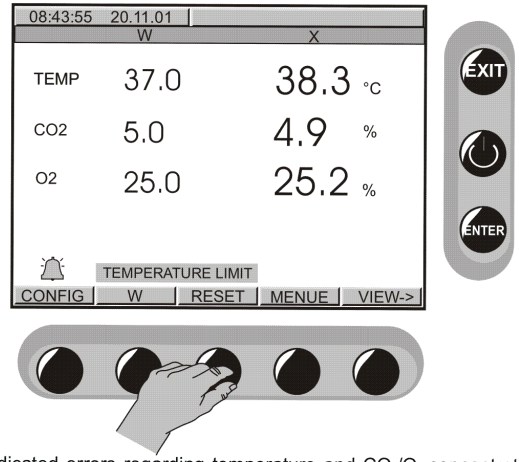
Art. No. 7001-0030
GB

Notes and alarm indications

urbances with their notes and alarm indications
ller type MB1:

ent	Note (blue field)	Alarm (red field)
	DOOR OPEN at once	DOOR OPEN >5 min.
too low (<0.8 bar)	LOW PRESSURE CO2 LOW PRESSURE O2 LOW PRESSURE N2 at once	LOW PRESSURE CO2 LOW PRESSURE O2 LOW PRESSURE N2 >5 min.
ture of more than ed set point	TEMPERATURE at once	TEMPERATURE >15 min.
t at the safety controller		TEMPERATURE LIMIT at once (w/o alarm contact)
centration of more than entered set point	CO2 at once	CO2 >15 min.
entration of more than entered set point	O2 at once	O2 >15 min.
ugged in or is faulty	!CO2-SENSOR! at once	
sterilisation process er chamber parts during sterilisation. touch !	STERI END at once	

This device is equipped with an intelligent electronic auto-diagnosis system. It indicates any disturbance at first as a blue hint on the screen. In case a faulty condition is not fixed during a tolerance time, a buzzer sounds and a potential free alarm contact is switched to transmit the alarm message to a central monitoring installation.



Indicated errors regarding temperature and CO_2/O_2 concentration can only be cancelled or confirmed within a tolerance bandwidth of +/- 1 by the RESET button. In case of larger deviations call our service.

Function alarm contact:

If there is no alarm indication, pin 1 and 3 are closed.
If case of an alarm, pin 1 and 2 are closed.

The maximum current across the contacts must not exceed 24 V AC/DC 2.5A.!

Possible distu
by the contro

Eve
Door open
Gas supply pressure
Deviation of tempera +/-1°C from the enter
Temperature limit se is exceeded
Deviation of CO_2 con +/-1 VOL.-% from the
Deviation of O_2 conc +/-1 VOL.-% from the
CO_2-sensor is not plu
End of the automatic
ATTENTION: The inn get hot Do not

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Copy

3 Function

Incubators series CB are suited for cultivation of mammal cells under typical conditions of about 37°C. The incubator allows the set defined pH conditions by justifying $NaHCO_3$ buffer systems of commercial cell media by keeping exact CO_2-atmosphere inside. CB incubators care for high humidity inside to avoid increasing of the osmolarity caused by evaporation of the cell media. To reach this, the different functions heating, sterilization and CO_2 injection have to work as a perfect team. This know-how is as Firmware inside the controller type MB1.

3.1 The CO_2-measuring principle

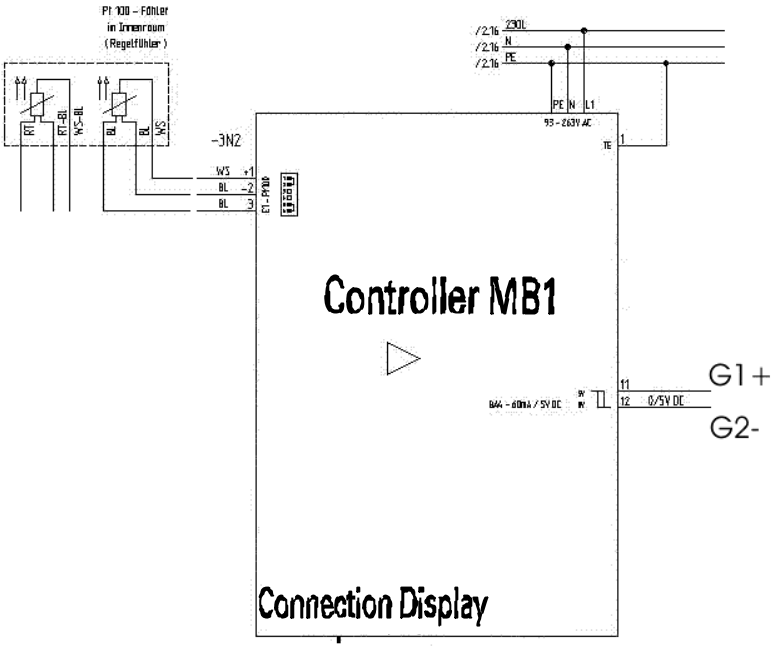
The CO_2-measuring procedure of the incubator series CB is characterized by fast reaction times, as well as the highest accuracy and selectivity. The accuracy of the CO_2 measuring system bases on a single-beam infrared measuring cell, which measures in differential mode, with permanently alternating transmission characteristic of its semi-conductor filter. Due to this highly developed single-beam principle with Fabry-Perot interferometer (FPI), disturbance variables and aging phenomena in the measuring system are almost completely eliminated, so that this measuring system, in contrast to other measuring procedures, remains practically drift-free between calibrations and is absolutely selective for CO_2.
The CO_2–measuring cell contains a measuring section inside in which the absorption of infrared light depends on the number of CO_2-molecules in the beam path. This number of CO_2 –molecules changes with the ambient pressure in relation to a constant volume. The distances between the molecules are consequently pressure-dependent. The collision frequency of the IR-beam with CO_2-molecules increases therefore by increasing pressure.

For this reason, the ambient pressure must be compensated in order to correct the display reading of the CO_2-concentration in VOL.-%. This is achieved by entering the altitude of the site above the sea which is described in this manual.

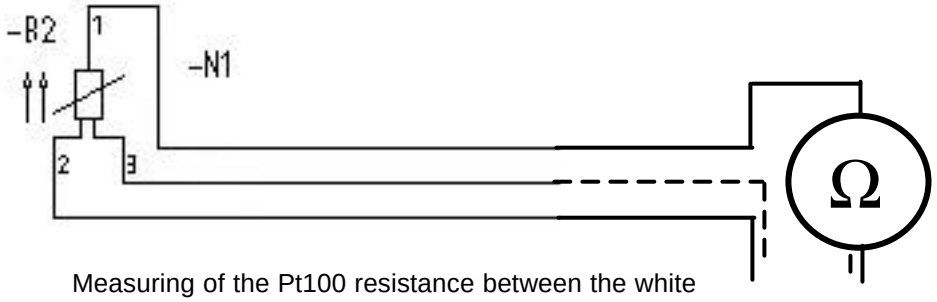
3.2 Function of the Heating System

The temperature measurement is realized by a PT100 temperature probe which changes his resistance at different temperatures. For example: 37°C = 114,380 Ω (see following chart).
The CB is equipped with a double PT100, one part is for the measurement inside the chamber, the other part is connected to the safety device class 3.1.
The measured value is evaluated in the controller MB1. The controller MB1 compares the set-value and the now measured value and decides to give a signal-current to the solid state relay –4K3 to activate the heating.

3.3 Flow-Chart of the heating function (basis CB 150 wiring diagram)



The Pt100 temperature probe is equipped with 3 cables, two red and one white cable.
The white cable is connected to pin 1 at E1 – Pt100, the two red cables at pin's 2 and 3 at E1 – Pt100.
To measure the resistance disconnect all three cables from the controller an measure between the white cable and one of the red cables, do not measure between both red cables.



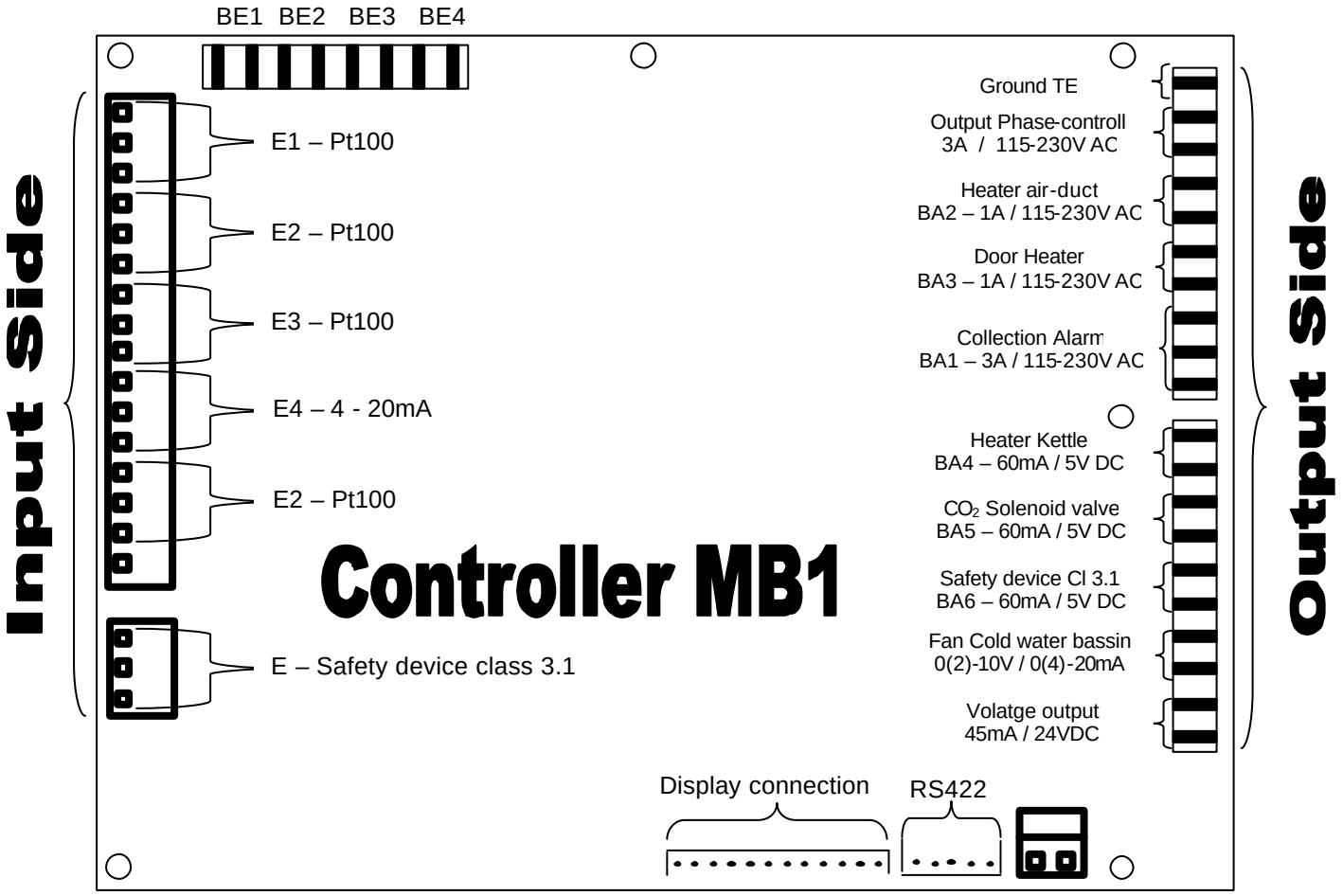
Measuring of the Pt100 resistance between the white cable PIN 1 and one of the two red cables PIN 2 or 3

Pt100 temperature probe (Temperature in °C / Resistance in Ω)

T (°C)	0	1	2	3	4	5	6	7	8	9	10
-10	96,086	96,478	96,870	97,262	97,653	98,045	98,436	98,827	99,218	99,609	100,000
0	100,000	100,391	100,781	101,172	101,562	101,953	102,343	102,733	103,123	103,513	103,902
10	103,902	104,292	104,681	105,071	105,460	105,849	106,238	106,627	107,016	107,404	107,793
20	107,793	108,181	108,570	108,958	109,346	109,734	110,122	110,509	110,897	111,284	111,672
30	111,672	112,059	112,446	112,833	113,220	113,607	113,994	114,380	114,767	115,153	115,539
40	115,539	115,925	116,311	116,697	117,083	117,469	117,854	118,240	118,625	119,010	119,395
50	119,395	119,780	120,165	120,550	120,934	121,319	121,703	122,087	122,471	122,855	123,239
60	123,239	123,623	124,007	124,390	124,774	125,157	125,540	125,923	126,306	126,689	127,072
70	127,072	127,454	127,837	128,219	128,602	128,984	129,366	129,748	130,130	130,511	130,893
80	130,893	131,274	131,656	132,037	132,418	132,799	133,180	133,561	133,941	134,322	134,702
90	134,702	135,083	135,463	135,843	136,223	136,603	136,982	137,362	137,741	138,121	138,500
100	138,500	138,879	139,258	139,637	140,016	140,395	140,773	141,152	141,530	141,908	142,286

For Example: Your resistance measurement system shows you 114,380 Ω this corresponds to 37°C.

3.4 Controller MB1 PIN description (Input / Output)

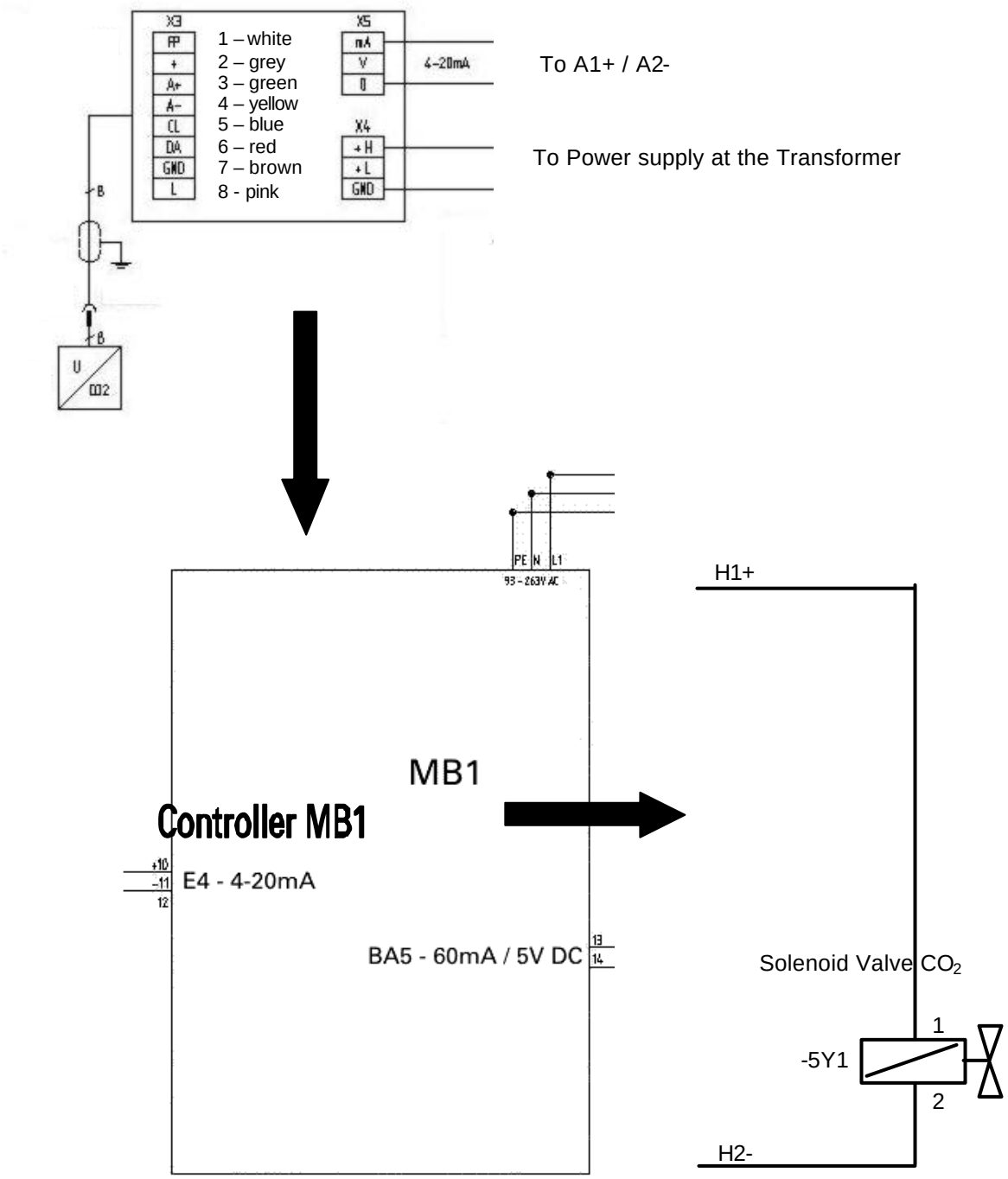


3.5 Function of the CO_2 System

The CO_2 System measures the CO_2 concentration inside the chamber. This information is supplied by the FPI Sensor Head. The Controller MB1 compares the engaged value with the now measured value and decides to open the solenoid valve of the CO_2 gas inlet.

3.6 Flow Chart of the CO_2 System (basis CB wiring diagram)

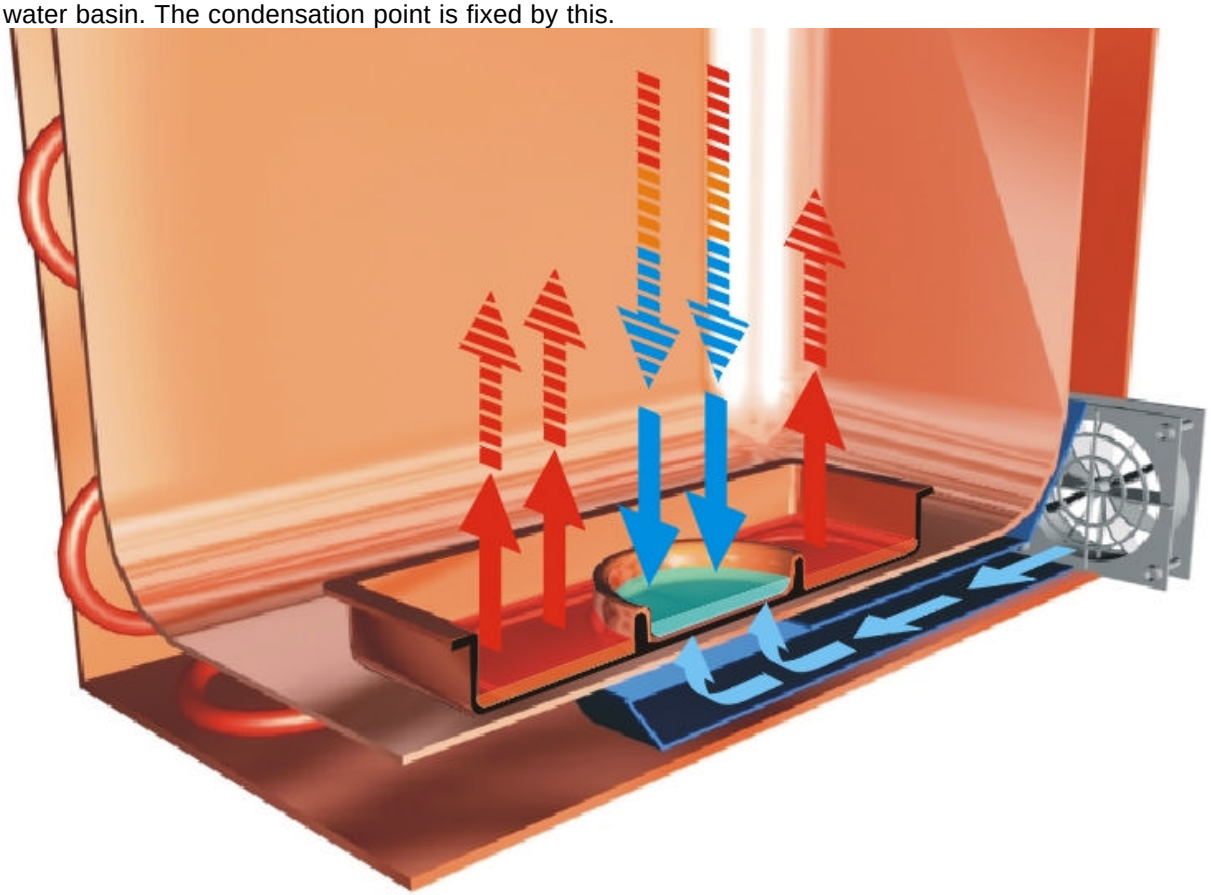
FPI-Sensor → FPI Sensor Board → Controller MB1 → Solenoid Valve → Gas Injection Nozzle



3.7 Function of the Permadry® system

Isotonic osmotic pressure ratios, essential for the growth of cells, are basically maintained in CO_2 incubators by a maximum humidity content in the inner chamber. During this process care must be taken to ensure the best possible protection against contamination.
The patented Permadry® system guarantees a humidity performance of up to 98% relative humidity with completely dry inner walls. The principle hereof is totally easy. The double basin system consists of a large-surface warm water basin an a cold water basin as defined condensation point. The temperatures of both basins are in that way controlled that the humidification and the dehumidification are permanently balanced. The Permadry® system works completely free of disturbances or maintenance. The handling of the Permadry® system is the easiest thing and as safe as a coffee cup. The basin is easily removable and can be refilled in or at the unit at any time.

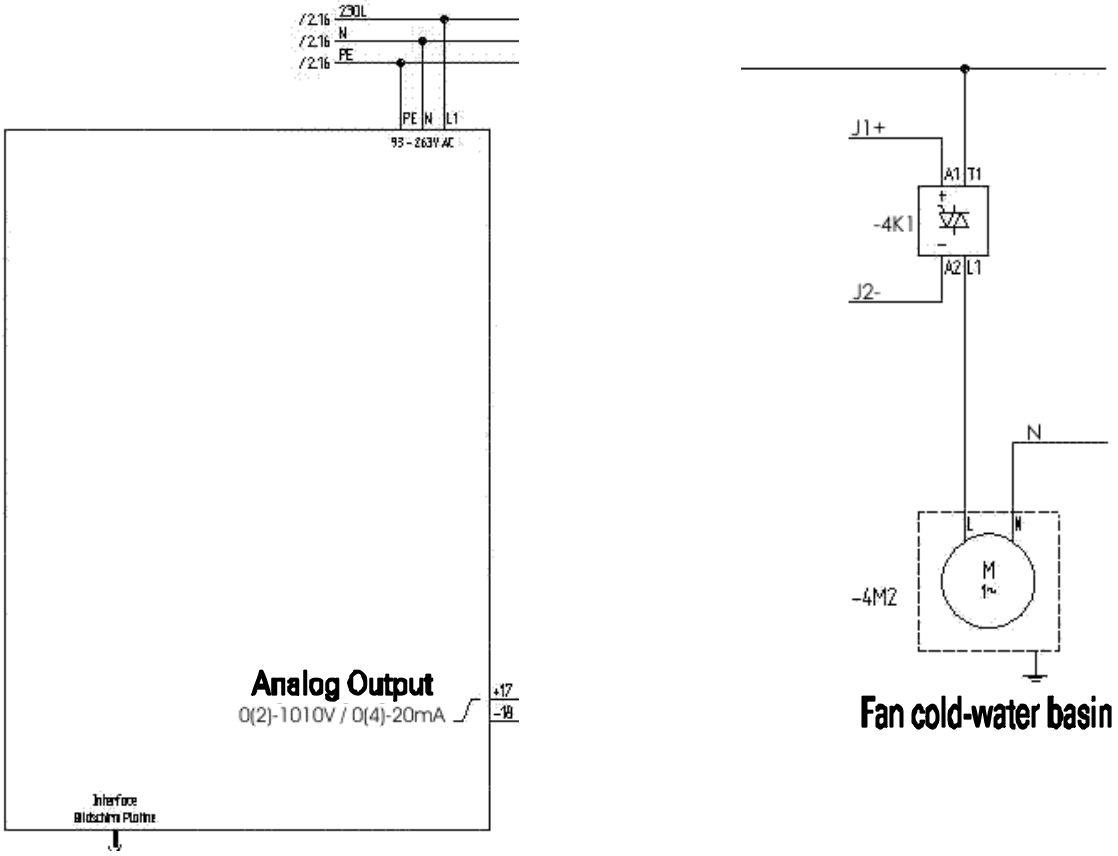
Cold air, produced by the Permadry® -fan, streams through the air-channel and cools the round cold water basin. The condensation point is fixed by this.



The Permadry® water basin must be placed correctly. There is a description „FRONT“ impressed.

3.8 Flow Chart of the Permadry® system (basis CB wiring diagram)

Controller MB1 → Permadry® fan



3.9 Description of the Function of the Fan Control

The CB heats up to the engaged set-value (°C), just before the chamber reaches the set-value the controller MB1 starts to pulse the heating signal. The ON/OFF rate is assigned by the regulation ration of the controller MB1.
The higher the regulation ratio, the higher is the fan speed. If the chamber doesn't heat (regulation ratio = 0) the fan is working with his minimal speed. If the chamber heats continuing (regulation ratio = 100%) the fan is working with his maximum speed. The speed of the fan is reduced to avoid kinetic influence of heating

The rotation of the Permadry®-Fan is reverse proportional to the rotation of the Mainfan.
The only difference is: The Mainfan is controlled constant with the help of a phase control level, the Permadry®-Fan is in interval mode which is given by a solid state relay.

3.10 Sterilization Mode

Depending on the resistance level of the germs, attention must be paid to the quality of the sterilization procedure. The lower the sterilization temperature the higher the risk of remaining germs and the longer the sterilization time is. With the standard hot air sterilization at 187,5°C it is absolutely guaranteed that all germs are reliably eliminated and, furthermore also time is saved.
All unit parts in the inner chamber are auto sterilized at a temperature of 187,5°C. The precision IR sensor is separately treated in a desinfectant bath. This ensures that the measuring quality does not suffer from the high temperature, as it may happen with other systems.

3.11 Hot-air sterilization

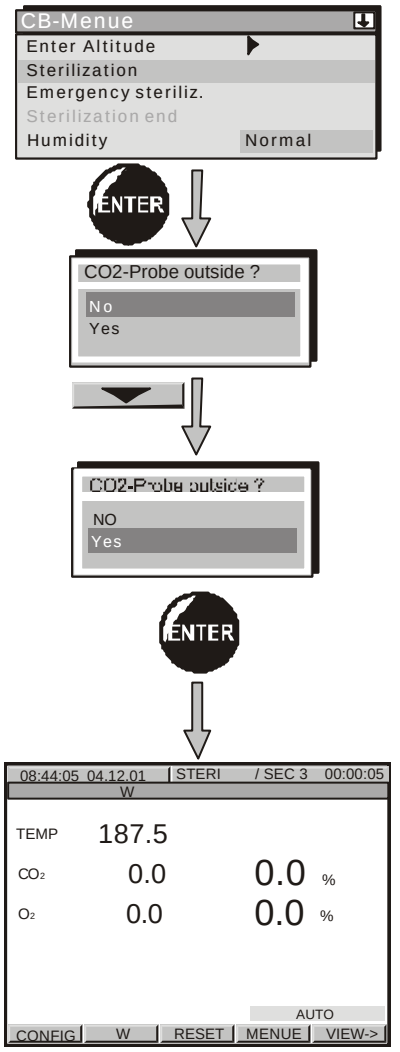
The hot-air sterilization gets activated in the CB Menu. The sterilization temperature of 187,5° C is adjusted by the manufacturer. It may not be changed.

The CO_2 sensor is temperature resistant up to a maximum temperature of 60° C.
By no means it can be sterilized or autoclaved.

The CO_2-sensor head is especially adjusted for a specific chamber that it belongs to. It cannot be operated in another chamber. There is an adhesive label with a number on the sensor head to avoid any mixing up.

Effect the hot-air sterilization as following:

1. Switch off the unit.
2. Pull out the CO_2 sensor (without rotating) from the connection bushing in the upper part of the rear and remove it from the inner chamber.
3. Only with option Oxygen control: Remove the oxygen sensor from the connection bushing without rotating and put it on the middle shelf.
4. Before starting the sterilization, please remove the water from the basin.
5. Shut the outer and the inner door of the unit.
6. Ensure that the water basins, the shelf holder and the shelves are in the inner chamber.
7. Switch on the unit.
8. Unlock the keypad of the controller MB1 with the key switch (option)
   (unlocked = horizontal position, key is removable).
9. Activate the sterilization procedure in the CB Menu as following:



Display during the sterilization process

Caution: Never open the two unit doors during the sterilization process, as the temperature reaction time will be interrupted and the sterilization will become ineffective.

10. The hot-air sterilization is automatically finished after 3 hours.
11. Switch off the unit and open the outer door.
    The temperature of the glass door handle is about 150°C. Use gloves or a tool (e. g. pincers) for opening the glass door, or let the unit cool down as follows: with opened front door for at least **1 hour**, with closed front door at least **4 hours.** Please make sure that the unit has cooled down to ambient temperature, but down to at least 60° C before plugging in the CO_2 sensor. In case of doubt, please wait at least 2 hours.
12. Befor putting into operation, please plug in the CO_2 sensor. Optional also the O_2 Sensor.

Due to the sterilization, units in copper version change their colour. This does not have any negative effect on the function and quality of the unit.

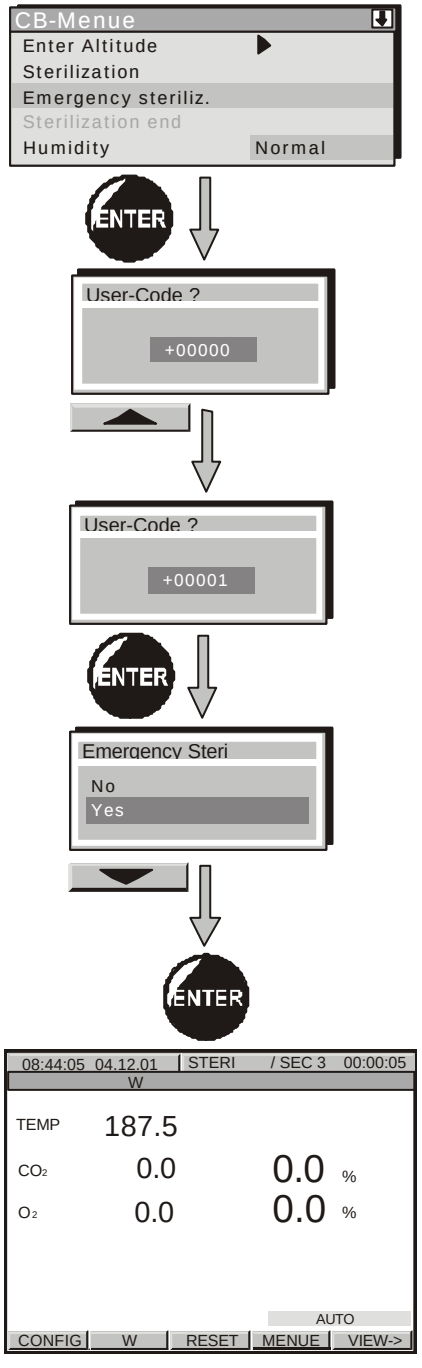
Caution danger of burning !
Due to the increased temperature performances there is the risk of burnings at the marked unit parts and especially at the inner glass door.
Do not touch !

3.12 Hot-air sterilization with inner chamber contaminated with highly infective material

If it is not possible to discharge the unit and to remove all necessary parts for safety reason, the hot-air sterilization can exceptionally be done nonetheless.

Attention! Note that this procedure destroys the CO_2 and the O_2 sensor (option)!

1. Shut the outer and the inner door of the unit.
2. Switch on the unit.
3. Unlock the keypad of the controller MB1 with the key switch (option) (unlocked = horizontal position, key is removable).
4. Activate the emergency sterilization procedure in the CB Menu as following:



Display during the emergency sterilization process

Caution: Never open the two unit doors during the emergency sterilization process, as the temperature reaction time will be interrupted and the sterilization will become ineffective.

5. The emergency hot-air sterilization is automatically finished after 3 hours.
6. The incubator is no longer ready for operation. Contact the BINDER service for repair.
   (As CO2 Sensor and/or O2 Sensordestroyed)

Due to the sterilization, units in copper version change their colour. This does not have any negative effect on the function and quality of the unit.

Caution danger of burning !
Due to the increased temperature performances there is the risk of burnings at the marked unit parts and especially at the inner glass door.
Do not touch !

4 Trouble Shooting

Safety hints: Do **never** unplug the CO_2 sensor head while the chamber is switched on. This could result in sensor destruction or initiation problems.

Hint: The tradename of the controller is MB1

<table>
<tr><th>Fault description</th><th>Fault cause</th></tr>
<tr><td>High CO_2 consumption</td><td>• If when the CO_2 is connected the max. pressure of 1,5 bar is exceeded, this can lead to a defect in the pressure switch. The pressure switch becomes leaky as a result and loses gas.</td></tr>
<tr><td>CO_2 too high inside the chamber

par example cell-medium is colored yellow = CO_2 too high</td><td>The controller MB1 shows also a too high concentration of CO_2:

• MB1 controller output which controlls the gas inlet valve is defect. There are continually 5V DC at controller output BA5.
• The solenoid valvet is mechanically defect, it doesn't close.
• The controller MB1 doesn't show a too high concentration of CO_2:
The FPI-Sensor System is defect. The Sensor outputsignal of the FPI-Sensor board could be checked according the following chart.

Binder offers a calibration kit for this purpose with analyzed test gas with a CO_2-concentration of 5 Vol.-%. Because the atmospheric pressure influences the measurement result of the CO_2 sensor system, the altitude of the site has to be taken into consideration.

Expected results during exposing the sensor head to 5% test gas:

<table>
<tr><th>Sea Level</th><th>Sensor Current</th></tr>
<tr><td>0 m</td><td>8,00 mA</td></tr>
<tr><td>100 m</td><td>7,93 mA</td></tr>
<tr><td>200 m</td><td>7,86 mA</td></tr>
<tr><td>300 m</td><td>7,79 mA</td></tr>
<tr><td>400 m</td><td>7,72 mA</td></tr>
<tr><td>500 m</td><td>7,66 mA</td></tr>
<tr><td>600 m</td><td>7,60 mA</td></tr>
<tr><td>700 m</td><td>7,55 mA</td></tr>
<tr><td>800 m</td><td>7,49 mA</td></tr>
<tr><td>900 m</td><td>7,44 mA</td></tr>
<tr><td>1000m</td><td>7,39 mA</td></tr>
</table>

If this values are not reached with a tolerance of +/- 0,24mA (corresponds to 0,3 Vol % CO_2) between the signal output of the FPI sensor board and the MB1 controller input from the sensor system is faulty.

• Replace the FPI sensor head and check the sensor current against the expected value again during exposing the sensor head to test gas.
If the deviation is now within the tolerance of +/- 0,24mA you can proceed a re-calibration at the MB1 controller as described in chap. re-calibration to achieve maximum accuracy.

• If this values are reached with a tolerance of +/- 0,24mA at the signal output of the FPI sensor board and yet the MB1 controller shows not a reading between 4,8 or 5,2 Vol.-% the MB1 is not calibrated correctly or it is faulty. Check the correct setting of the altitude above see level which is essentially for correct CO_2 values displayed on MB1-controller display (see CB operating manual). Try a re-calibration (see chapter re-calibration) with the correct altitude setting set before.</td></tr>
</table>

<table>
<tr><td>MB1 controller display shows CO_2 readings of 19 to 20 Vol.-% CO_2 also when there is no CO_2 inside the chamber e.g. with open door.</td><td>• This means the new plugged CO_2 sensor head is not initialized successfully.
• Try a restart of the chamber by switching OFF and after 10 s ON an the main switch.
• If this worse reading still remains the sensor board has to be replaced and a re-calibration must be carried out.</td></tr>
<tr><td>FPI sensor board:
Red and green error LED flash alternately</td><td>• This means no connection between sensor head and the FPI sensor board.
• The sensor head is not plugged correctly – try to plug it again.
• The red silicone wire between the Lemo socket for the sensor head and the FPI sensor board is faulty.
• The soldered contacts of the Lemo socket might be unfixed.</td></tr>
<tr><td>FPI sensor board:
Green LED flashes and lights alternately.</td><td>• Normal function, no defect.</td></tr>
<tr><td>FPI sensor board:
Red LED is continuously on or flashes (green remains off) during normal operation</td><td>• Sensor system is faulty. The sensor head and may be the sensor board must be replaced. The system must be re-calibrated (see chap. re-calibration)</td></tr>
<tr><td>CO_2 too low inside the chamber

par example cell-medium is colored violet = CO_2 too low</td><td>The controller MB1 shows also a to low CO_2 concentration:
• Check the pressure of the CO_2 bottle (max.1.5 bar, min. 1.0 bar)
• Sterilization process has to be off
• Check gas inlet valve. When the door is closed the valve has to open with a clicking noise.
• The door switch has to be in closed position when the door is closed. If it is not closed no CO_2 can flow inside the chamber. Press the door switch by hand and check on the inlet tube whether CO_2 is flowing in
• Check CO_2 connection (rear), and the 1mm drill hole of the gas mixing head. May be there is something jammed.

The controller MB1 doesn’t show a to low CO_2 concentration:
The CO_2 Sensor System is defect. The Sensor Outputsignal of the FPI-Sensor board to the controller MB1 could be checked according the following chart.

Binder offers a calibration kit for this purpose with analyzed test gas with a CO_2-concentration of 5 Vol.-%. Because the atmospheric pressure influences the measurement result of the CO_2 sensor system, the altitude of the site has to be taken into consideration.

Expected results during exposing the sensor head to 5% test gas:

<table>
<tr><th>Sea Level</th><th>Sensor current</th></tr>
<tr><td>0 m</td><td>8,00 mA</td></tr>
<tr><td>100 m</td><td>7,93 mA</td></tr>
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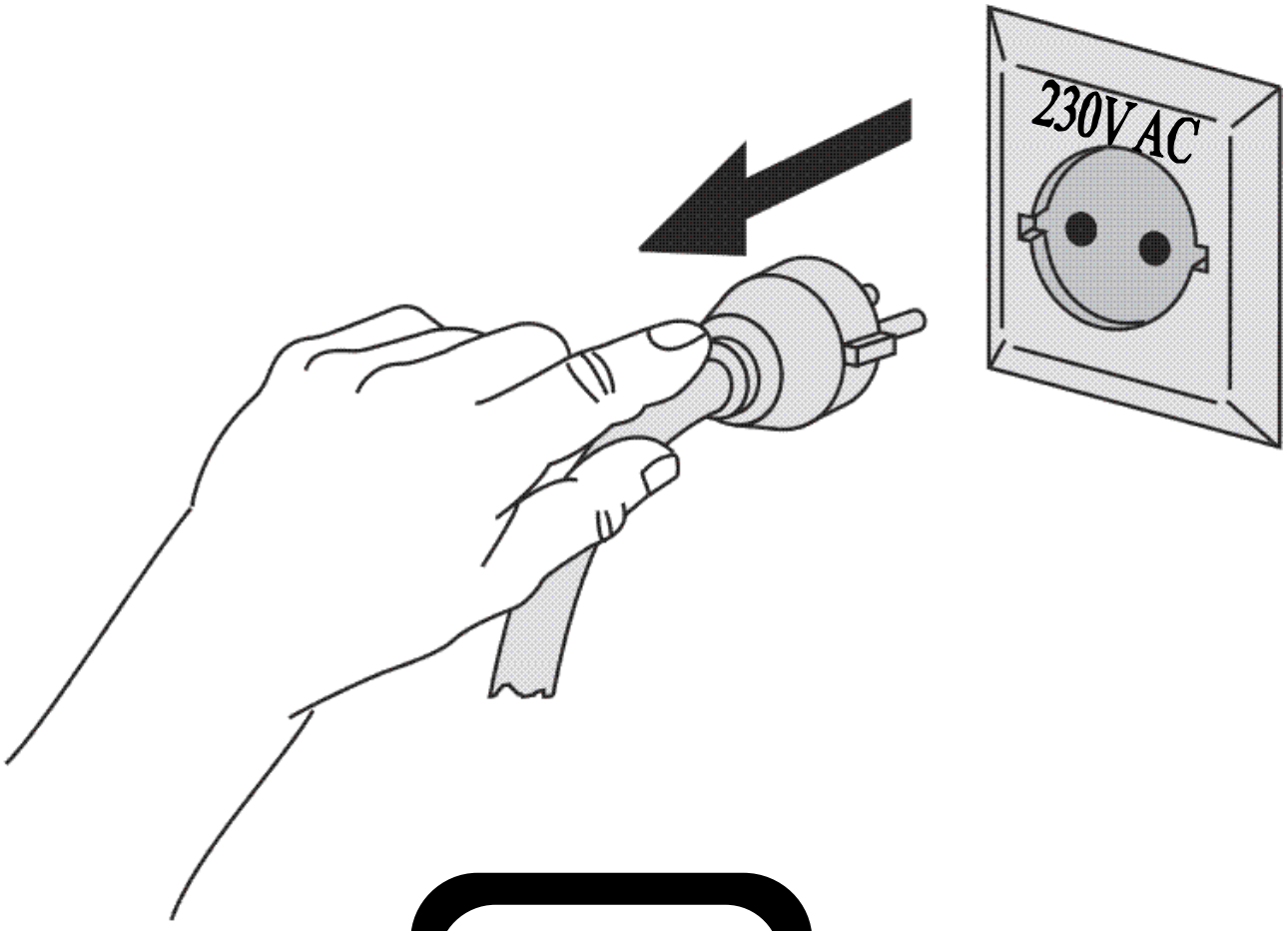
<tr><td>500 m</td><td>7,66 mA</td></tr>
<tr><td>600 m</td><td>7,60 mA</td></tr>
<tr><td>700 m</td><td>7,55 mA</td></tr>
<tr><td>800 m</td><td>7,49 mA</td></tr>
<tr><td>900 m</td><td>7,44 mA</td></tr>
<tr><td>1000m</td><td>7,39 mA</td></tr>
</table>

If this values are not reached with a tolerance of +/- 0,24mA (corresponds to 0,3 Vol % CO_2) between the signal output of the FPI sensor board and the MB1 controller input from the sensor system is faulty.</td></tr>
</table>

	• Change the FPI Sensor Head and check the Sensorcurrent against the table above during exposing with 5% CO_2 Testgas • If the deviation is within the tolerance of +/- 0,24mA, please make a re-calibration. • If the value with the tolerance of +/- 0,24mA at the signal output of the FPI Sensor board is reached but the controller doesn't show a value between 4,8 and 5,2 Vol.-% CO_2, there was a wrong calibration done. Check the correct setting of the altitude and make a re-calibration. • **Make sure, that you have reset the old calibration**.
The CO_2 concentration doesn't go down after a door opening of approx. 20s to 0 Vol.-% CO_2	• Check the altitude setting at the MB1 controller • The Sensor system is defective or wrongley calibrated • Make a re-calibration and check if the value is now ok. • If not, you have to change the sensor system. Change first only the FPI sensor head and make a re-calibration.
The CO_2 concentration drifts during exposing with 5%-Testgas	• If the signal doesn't reach a stable value, you have to change the sensor system, first only the FPI sensor head, after that you have to make a re-calibration
CO_2 Controller shows „-1999". There's also a red alarm-bell blinking	Means measurement value underrange: • The Sensor signal between the Sensor Board and the Sensorinput E4 at the controller MB1 is low. (under 4mA) • Check if the sensor head puts correctly • Check the cable between the Sensor Board and the controller MB1 looking for a break or a faulty contact. • Check the cable between the Sensor Board and the sensor • If the controller gets the correct signal, but shows still –1999, the input at the controller is defect. The controller must be changed. • There's no current from the transformer (24VDC). Check the power supply for the FPI sensor. Possibly, the fuse is blown (T500mA).
CO_2 controller shows "9999"	Means measurement value exceeding • The sensor signal between the FPI sensor board and the sensor input at the controller MB1 at Pin E4 is to high (over 20mA) or there's a initialization error – try a restart. • If the red LED of the sensor board is lit permanent, you have to change the sensor board. • If not, check the sensor current and the sensor output of the sensor board. • Try a re-calibration with analyzed testgas • If the error reshows, you have to change the controller
To low humidity inside the chamber	• The stpoint of the door heating is to high. (This is a internal setting of the controller. Please see description in chapter 4.4)
Humidity to high inside the chamber Condensation inside	• The Permadry® fan doesn't run. This fan is for blowing cold air throgh the air chanel to the cold water basin
Condensation at the glass door	• Check the outer door and the inner door fits not tightly • Check the two door sealing. • Adjust the door keeping • The door heating element is faulty – Check the resistance (normally 278 Ω).

5 Most common service work

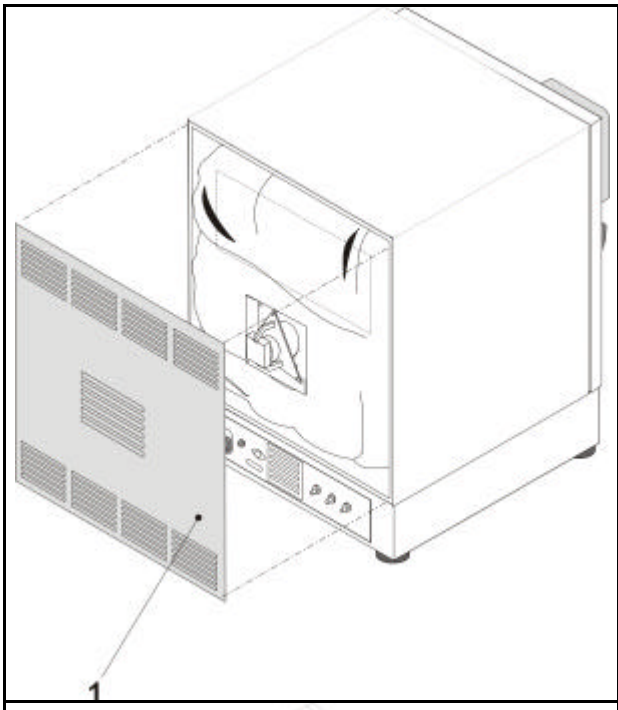


Please note:

Please unplug when servicing or working on electronic part

It's for your own protection

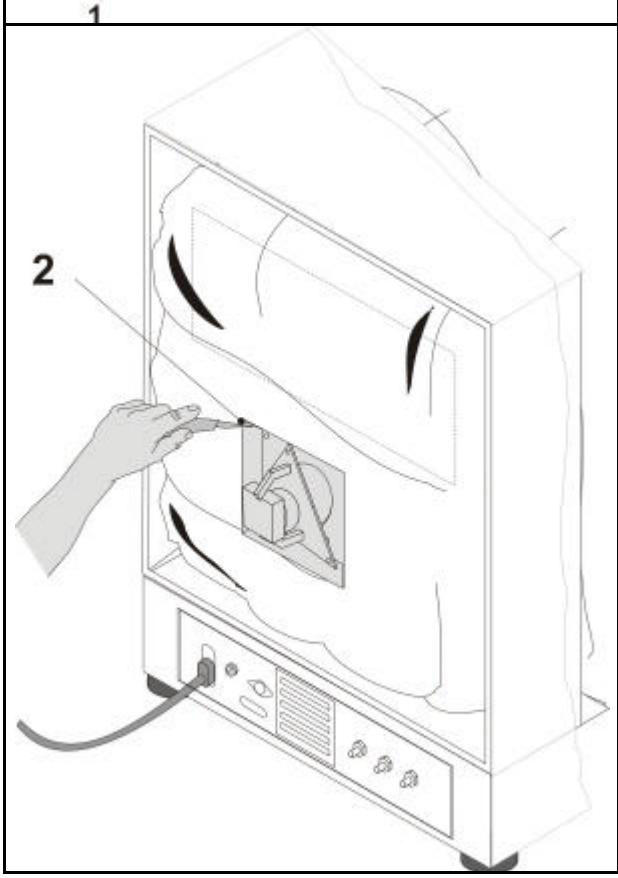
5.1 Changeing of the fan



If it is possible for the intended service work the mains plug should be pulled.

Note:
The fan motor turns when the chamber is switched on.

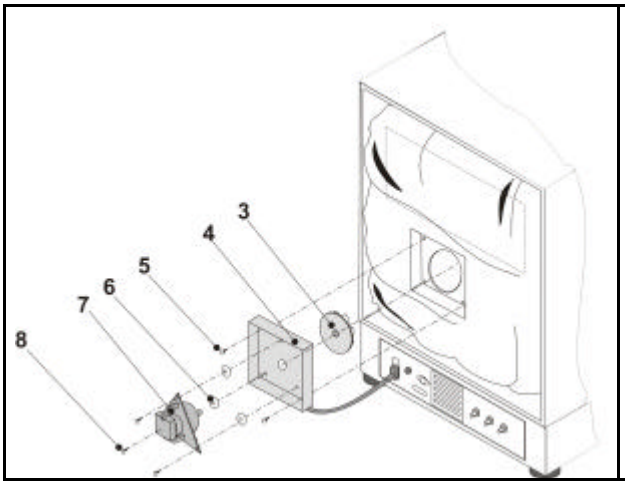
Remove the rear wall of the chamber by use of a plus driver.



You have to cut the aluminium tape around the fan mounting plate.

Remove the two connectors to the fan motor.

Removed the 4 screws of the plate of the fan motor (sheet metal frame).

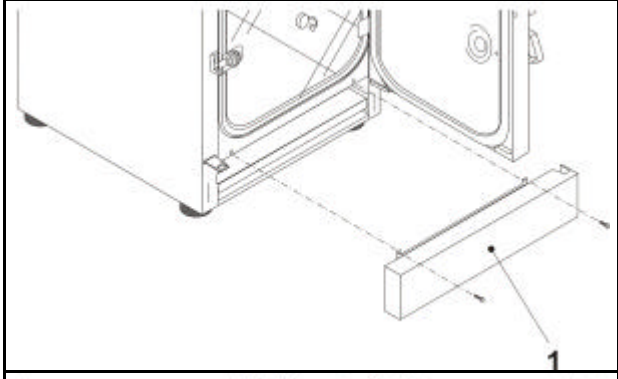
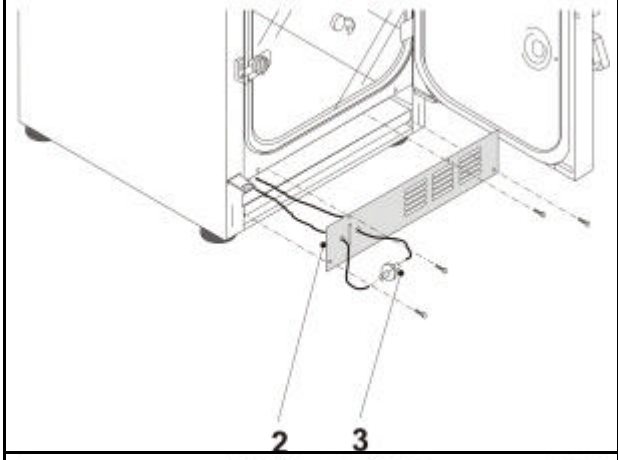
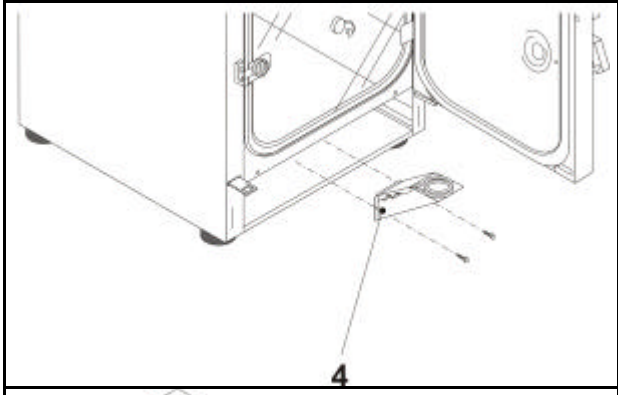
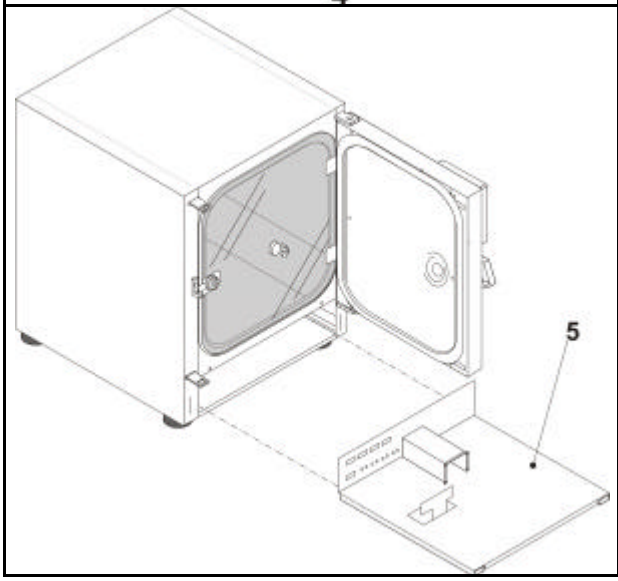


Unscrew the axis nut of the fan wheel (left turning thread !) with a spanner size 13. Remove fan

Assemble the new fan motor in reversed order.

Replace Aluminium Tape.

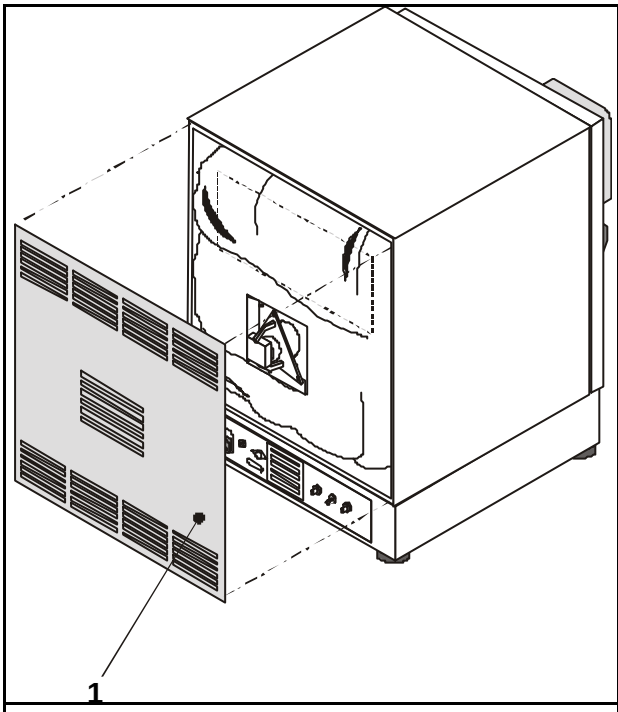
5.2 Take out of the electronic component board

	Open the glass door and then the two screws at the cover. After unscrew you have to press down the cover to take it off.
	Now you can change the steri filter. The cover plate is fixed by 4 screws.
	Before you can take out the complete component board, **please check that the power supply is disconnect.** Please remove the drawn part of the air chanel of the Permadry® system before you take out the component board.
	Now lift the component board and take them out forwards. Now it is possible to change all electronic parts. If you plug in the power supply to measure some parts, be carefull, there could be 230V AC.

5.3 Opening of the rear service lid to achieve the area of the air jacket

This is necessary for following service works.

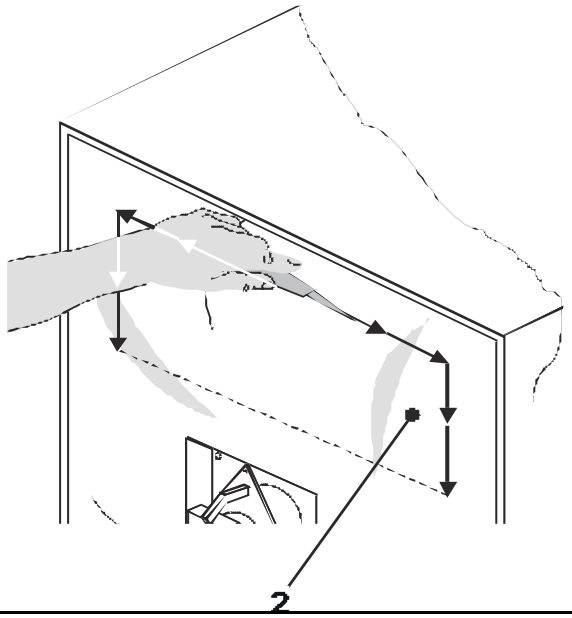
- To replace the temperature probe of the air jacket
- To replace the socket of the FPI-sensor head
- To replace the gas mixing head
- To replace the double temperature probe for inner temperature and safety device



If it is possible for the intended service work the mains plug should be pulled out.

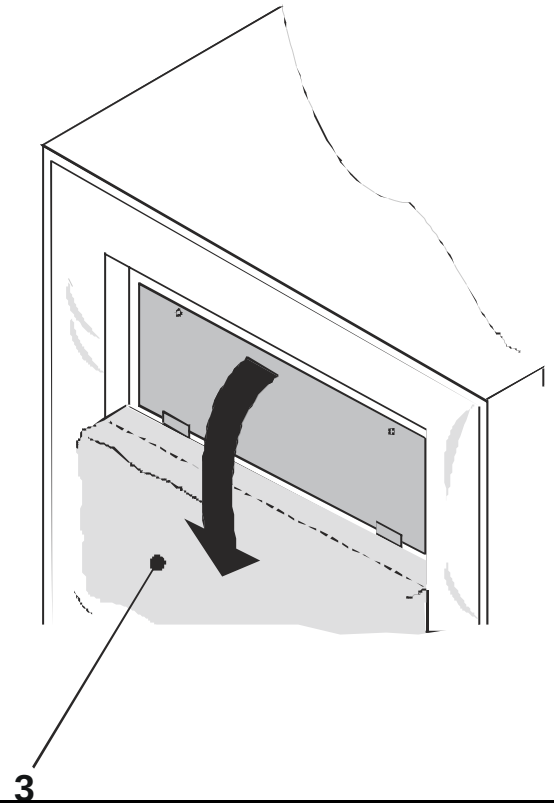
Note:
The fan motor turns when the chamber is switched on.

Remove the rear wall of the chamber by use of a plus driver.



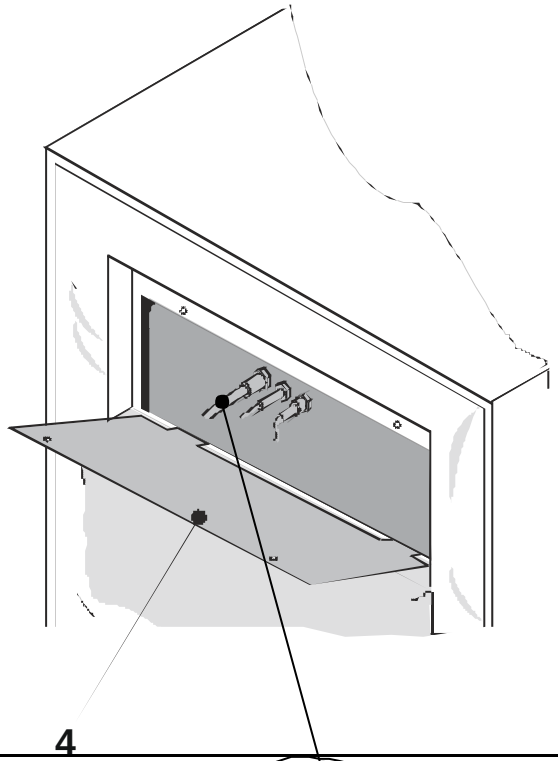
Cut the aluminum foil with a sharp knife at the upper area as shown.

Note that it should not be cut up all around. Cut only the top line and the two sides



Fold up the insulation as shown beside.

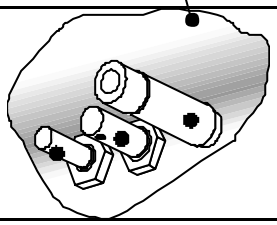
Remove the parker screws which fix the metal cover.



Remove the metal cover sheet.

Now you have access to following parts:

- socket of the FPI-sensor head gas mixing head double temperature probe for inner temperature and safety device



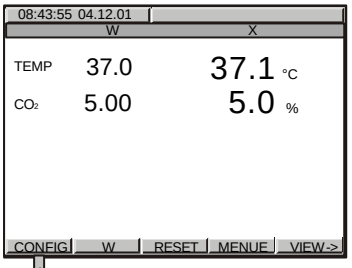
Inner view:

- left: double temperature probe for inner temperature and safety device
- middle: gas mixing head
- socket of the FPI-sensor head

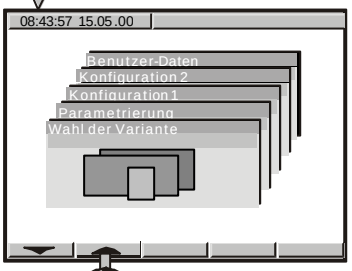
5.4 Setting of the door heating

This function is needed, to stop condensation at the glass door.
Make sure that the outer and inner door seal tightly

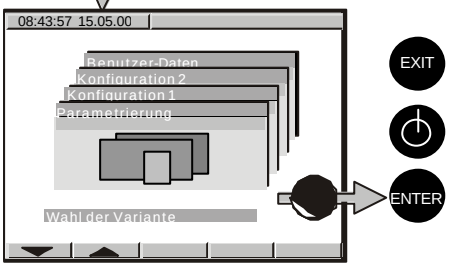
1.



2.

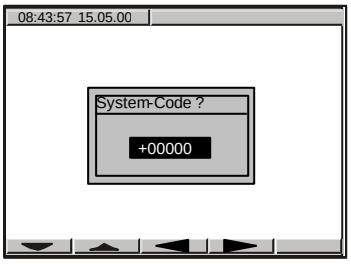


3.



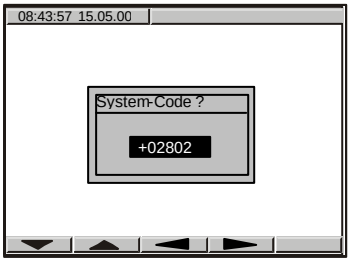
Now you are at the System-Code input field

4.

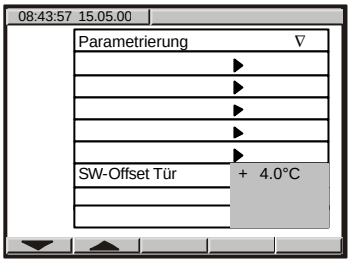


just type 2802 and confrim with ENTER

5.



5.



6.

Press the Button ▼ up to SW-Offset door press ENTER to confirm. Now you can set the desired value.

Then press EXIT to come back to standard display

CAUTION:

The System-Code is only for Service-Engineers. Don't give the System-Code to the customer, it is possibl eto change also the parameters, so that the chamber couldn't work

5.5 CO_2-Reference Measurement

The CO_2-measuring procedure of the incubator series CB is characterised by fast reaction times, as well as the highest accuracy and selectivity. The accuracy of the CO_2 measuring system bases on a single-beam infrared measuring cell, which measures in differential mode, with permanently alternating transmission characteristic of its semi-conductor filter. Due to this highly developed single-beam principle with Fabry-Perot interferometer (FPI), disturbance variables and aging phenomena in the measuring system are almost completely eliminated, so that this measuring system, in contrast to other measuring procedures, remains practically drift-free between calibrations and is absolutely selective for CO_2.
The CO_2–measuring cell contains a measuring section inside in which the absorption of infrared light depends on the number of CO_2-molecules in the beam path. This number of CO_2 –molecules changes with the ambient pressure in relation to a constant volume. The distances between the molecules are consequently pressure-dependent. The collision frequency of the IR-beam with CO_2-molecules increases therefore by increasing pressure.

For this reason, the ambient pressure must be compensated in order to correct the display reading of the CO_2-concentration in VOL.-%. This is achieved by entering the altitude of the site above the sea which is described in the CB operating manual.

It is a common desire of customers to make test-measurements between the re-calibrations implemented as a part of the recommended annual maintenance work.

In principal there are 3 possibilities to test CO_2-concentration inside a incubator which are described later on.

5.5.1 Measuring of CO_2 indirectly via the pH of the cell medium

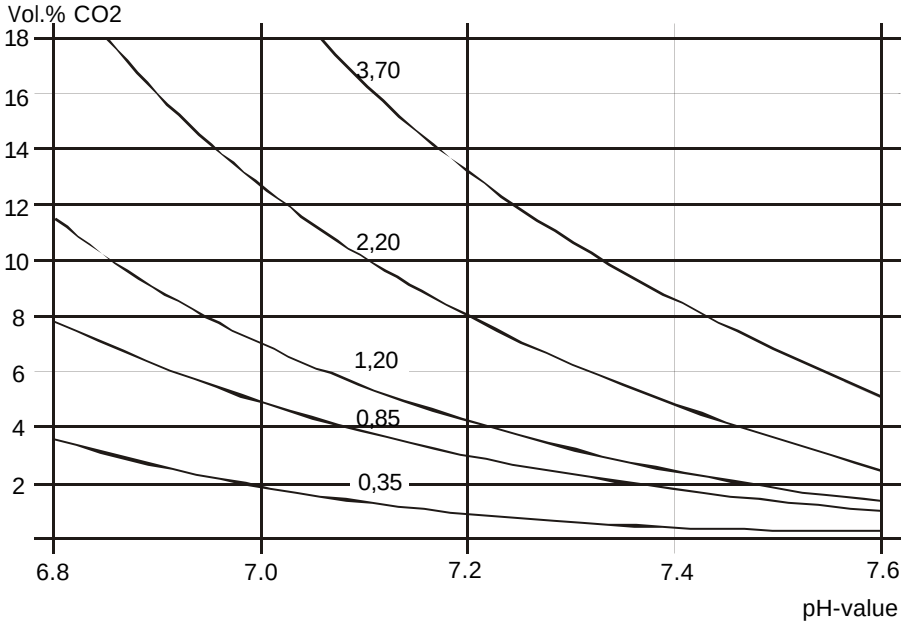
By use of the indirect determination of CO_2 concentration via the pH-value of the nutrient it is possible to check the CO_2-concentration inside the chamber. This method can not be used for re-calibration of the sensor system but it is a simple method to test for the correct CO_2 concentration without any special CO_2-measuring equipment. Only a accurate pH indicator or a pH measuring electrode is necessary, but this is standard equipment in cell culture laboratories.

This method bases on the acid base equilibrium of the buffer system in the nutrient.

The most common media are buffered by $NaHCO_3$. With the help of the pH-value in the medium, a conclusion can thus be drawn about the concentration of CO_2.
This conclusion is directly possible using the diagram below, which expresses the interrelationship between CO_2 concentration in vol. % and the pH of different $NaHCO_3$ buffered media.

We recommend the incubation of an empty sample with medium for 1/2 day under the same conditions as the cells. The incubation can be performed in a cell culture bottle or in a 50 ml Falcon tube with open lid.
After gassing, remove the empty sample from the incubator and within 5 minutes measure the pH1-value with a glass electrode. During the measurement the medium should have the least possible surface contact with the ambient air, so that the CO_2 can only diffuse out slightly. Therefore, transfusing should be avoided. A significant downward movement will only be observed after 5 minutes, allowing sufficient time for measurement. Naturally, pH-test strips can also be used (pH6-8 range not bleeding).

Following graph shows the pH-value of $NaHCO_3$ buffered media as function of the CO_2-concentration:



Trade names of common media:

	NaHCO3 [g/l]
DMEM	3,70
BME	2,20
MEM	2,20
Medium 199	2,20
Mc Coy	2,20
F10	1,20
F12	1,20

Example:
If a pH of 7,2 is measured in a medium which is buffered with 2,20 g NaHC03 per liter there must be 8 Vol.-% CO_2 in the surrounding of this medium.

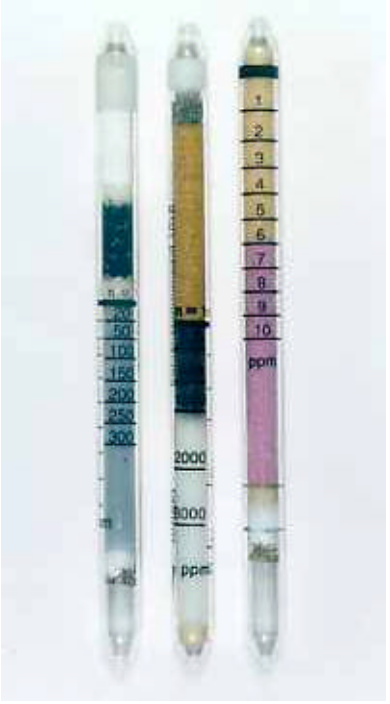
5.5.2 Measuring of CO_2 directly via chemical indicator tubes

This is a common do it yourself test of the users. A chemical color reaction in a glass tube shows the CO_2-concentration. A standardized volume of air from the inside of the incubator has to be sucked through this glass tube to get a quantitative test result. Therefor a special hand pump must be used with a standardized suction volume.

Example for such a procedure:

1) Break off both ends of such a glass tube or remove the plugs.
2) Pin that end with the higher end of the scale on the adapter of the hand pump which belongs to that test system.
3) Pin the other end trough the silicon plugged access port of the inner chamber door (4) of the CB incubator.
4) Take one sample volume out of the inner camber volume by pressing the pump entirely together and releasing it afterwards.
5) The standardized volume is sucked trough the glass tube and the chemical indicator changes its color beginning from the side pinned into the chamber in direction to the hand pump.
6) The more CO_2 is inside the chamber the vast the chemical reaction will cause a change of the color of the chemical reactor.
7) The CO_2 concentration can be read off by the scale directly printed on the glass tube or a delivered reference reading rule.

It is necessary to correct the result with the current ambient pressure. The necessary formula is printed on the instruction sheet of such systems.



Example for chemical indicator tubes

Notes:

All the necessary equipment must be delivered by only one manufacturer and one defined test system.

This test systems are nor very accurate.
A typical accuracy is around 10% of the full scale value!

Therefor this system should not be used for re-calibrating the BINDER FP-sensor system.

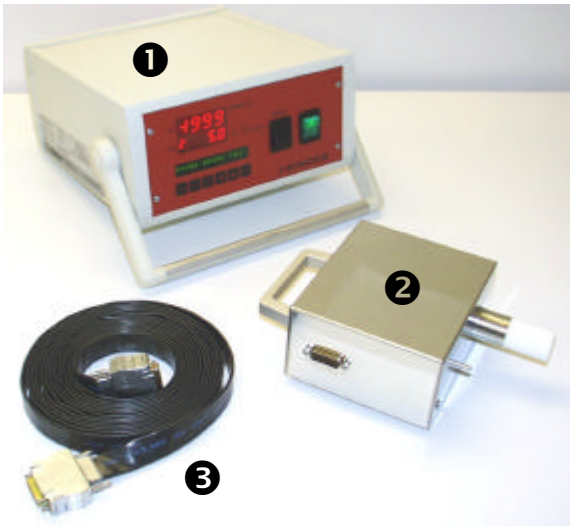
Example for hand pump (foreground) or a electrical pump (background)

5.5.3 Measuring of CO_2 directly via a electronic measuring device

The easiest way to measure CO_2 concentration are electronic sensor systems. BINDER offers the portable measuring device model CTM 01 which were specially designed to measure CO_2 concentration and temperature inside of CO_2 incubators. The CTM 01 can be used both for reference measurements in certified laboratories, as well as for service purposes.

Description of CTM01:

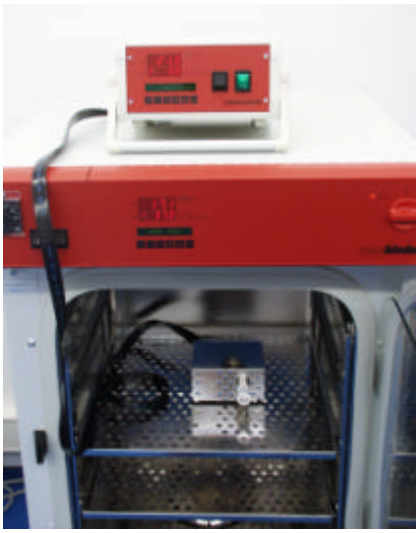
- The measuring system consists of 2 parts: The measuring station, which remains outside the CO_2 incubator, and the sensor housing, which is put in the center of the usable volume of the incubator. Both parts are connected by a ribbon cable, which can be laid across the door gasket of the incubator without causing leakage.
- The measuring cell is placed directly in the atmosphere to be measured. This means that there is no requirement for gas pumps, whose inconstant flow rates can cause inaccuracies. When converting the measured variable, partial pressure CO_2, to the display value, VOL.-% CO_2, the respective altitude above sea level is entered and taken into account, so that the display value always corresponds immediately to the real concentration in VOL.-% CO_2 , irrespective of the place of use.
- The temperature is determined via a PT100 temperature sensor and is displayed on the large LED display in 10 seconds alternation with the CO_2 - concentration.
- The measured data of temperature and CO_2 -concentration are output to an RS 422 interface. Thus the measured data can be simple recorded, stored and graphically represented via PC using the APT-COM communication software developed by BINDER.
- For monitoring, the nominal values set in the incubator can be entered into the mobile measuring system. If these nominal values are exceeded or fallen below by permanently set tolerances, this is reported by the unit optically and acoustically, as well as via a potential-free alarm contact. The alarm function only becomes active if both measured values were previously within the tolerance limits.



❶ Measuring station

❷ Sensor housing

❸ Ribbon cable



Measuring in a BINDER incubator type CB
(door is normally closed during measurement)

6 Calibration

6.1 Definition of calibration

In this service manual the word “calibration” means to adjust the actual value readings of the MB1 controller for the two controlled values of the CB incubator which are CO_2 concentration and temperature to accurate references of known value. Other words e.g. “alignment” are also customary for the same procedure.

6.2 References for calibration

Reference for temperature:
A electronic measuring- and display device for temperature which is traceable to a acknowledged standards/calibration institution (DKD , PTB for Germany) with valid calibration certificate.
The cable to the sensor probe must be thin to cause no leakage when it is laid between via the door sealing.

Reference for CO_2 concentration
Two test gases with analyzed concentration are used to which the FPI sensor head is exposed directly.
BINDER offers a calibration kit with all necessary gases and accessories. The third bottle is only needed for option O_2-control..

6.3 Tolerance of the adjustment

Binder calibrates each chamber before it is dispatched to the customer. High-quality measuring systems are used for this, whose accuracy is tested annually. To guarantee best possible quality of results which are worked out by use of the CB incubator the controlled values should be checked annually and re-calibrated if necessary.

When is it worth to correct a deviation between the value measured and the value displayed on the MB1 controller?
The following table gives you the conditions for an ideal adjustment of a temperature deviation,

Measured value	**Measured range**	**2 points adjustment**	**Adjustment if deviation is higher than:**
Temperature CO_2 volume in %	Up to 60°C CO_2 volume in %	37°C (2^{nd} point not used) 0 Vol.-% and 5 Vol.-%CO2	+/- 0,3K +/- 0,3 Vol.-% CO_2

Deviations which are smaller than this deviations do not require an adjustment.

Important:
The values on the above chart can only be used if the value of measurement uncertainty on the calibration certificate of the measuring instrument is smaller than the values of the chart.
When this is not the case, then you must take as limit value for an adjustment the measurement uncertainty value of the calibration certificate.

Calibration instructions for CO2 incubator CB with screen controller MB1

Temperature / CO2 / O2 controller

Measurement device for temperature

Type:	
Identification No.:	
Traceability:	
Date of calibration:	
Measuring uncertainty of the measuring device:	

Temperature calibration

The temperature calibration is effected in one single procedure at the most common working temperature (mostly used 37°C) in thermal stationary condition. The unit is checked in empty condition with one central shelf.
The reference sensor for temperature is led into the empty inner chamber through the door sealing and is positioned in the middle of the usable volume on one central shelf. Both unit doors remain closed during the calibration. The incubator has to be pre-heated at the calibration temperature for at least one hour.

The adjustment of the temperature controller is only necessary in case there is a deviation between the temperature, measured in centre of the useful volume and the reading of the actual temperature displayed on the controller MB1 or its safety controller of more than +/-0.2 K. In case the reference instrument has a measuring uncertainty larger than +/-0.2 K (see its calibration certificate), this is the confidence criteria.

Test for the necessity of a temperature calibration (adjustment of the controller)

Temperature set-point W	_____°C
Display reading of the controller	_____°C
Display reading X of the safety controller in menu “user-settings”	_____°C
Display reading of the reference instrument	_____°C
Divergence actual temperature - Reading reference instrument	_____°C
Divergence actual temperature of the safety controller - Reading reference instrument	_____°C

Measuring uncertainty of the reference instrument _____°C

	Yes	No
Calibration (adjustment) of the temperature controller necessary	☐	☐

In case of "No" chap. 3 can be skipped.

Notes: Repeated calibrations are recommended in periods of 12 months.

Calibration (alignment) of the temperature controller

Overview :

First of all the former calibration is reset (see chap. reset of the calibration). The input value correction is deactivated afterwards (set the state of the input val. correction to Off). Then return to the normal operation mode and let adjust the incubator for 1 hour to the calibration temperature.

The display reading values of the inner chamber temperature (Analogue input 1), of the preheating chamber temperature (Analogue input 2) and of the safety controller are set to the display reading value of the reference instrument. This is done by entering the display value of the reference instrument to the menu "Input value correction" of analogue input 1, analogue input 2, and of the safety controller.

Finally the input value correction is activated (set the state of the input val. correction to On).

Reset of former calibrations

Normal Display ® ***Config*** ® *Configuration 2* ® ***System-Code 2802*** ® ***Service Level*** ® *Inp. Val. correct.* ® *Analogue input 1*

Enter the value 0 to *Start Value X.*
Enter the value 0 to *Start Value W.*
Enter the value 1000 to *End Value X.*
Enter the value 1000 to *End Value W.*

Set *State* ***to Off***

® ***EXIT*** ® *Analogue input 2*

Enter the value 0 to *Start Value X.*
Enter the value 0 to *Start Value W.*
Enter the value 1000 to *End Value X.*
Enter the value 1000 to *End Value W.*

Set *State* ***to Off***

® ***EXIT*** ® *Safety controller*

Enter the value 0 to *Start Value X.*
Enter the value 0 to *Start Value W.*
Enter the value 1000 to *End Value X.*
Enter the value 1000 to *End Value W.*

Set *State* ***to Off***

® ***leave menu with 4 x EXIT.***

Entry of the *r*eference temperature

Starting Situation:
During 1 hour without door opening the incubator is adjusted stable to the calibration temperature (e.g. X = W = 37°C).
The reference instrument shows e.g. 36.5°C.

Reading out of the actual values:

Normal Display ® ***Config*** ® *Configuration 2* ® ***System-Code 2802*** ® ***Service Level*** ® *Analogue Inputs* ® ***read out and note*** *1.* ***and*** *2.*
® ***leave the menu with 3 x EXIT***

Normal Display → **User-Settings** → read out and note “Safety control.Act.”
→ leave the menu with EXIT

Example:

Reference device	Analogue Input **1.** equals value X = value W in Normal display	Analogue Input 2.	Safety control.Act
36.5°C	37.0 °C	36.7°C	36.9°C

Entries:

Normal Display ® ***Config*** ® ***Configuration 2*** ® ***System-Code 2802*** ® ***Service Level*** ® ***Inp. Val. correct.*** ® *Analogue input 1*

Enter the display value of the controller (e.g. 37.0°C) to *End Value X.*
Enter the display value of the reference instrument (e.g. 36.5°C) to *End Value W.*
Set *State* ***to On***

® ***EXIT*** ® ***Inp. Val. correct.*** ® *Analogue input 2*

Enter the display value of analogue input *2.* ***(e.g. 36.7°C) to*** *End Value X.*
Enter the display value of the reference device (e.g. 36.5°C) to *End Value W.*
Set *State* ***to On.***

® ***EXIT*** ® ***Inp. Val. correct.*** ® *Safety controller*

Enter the value Safety control.Act (e.g. 36.9°C) to *Start Value X.*
Enter the display value of the reference instrument (e.g. 36.5°C) to *Start Value W.*
Check and enter if needed the fix value 187°C to *End Value X.*

Check and enter the fix value 175°C to *End Value W.*

Set *State* ***to On***

® ***leave the menu with 4 x EXIT.***

The corrected value appears on the controller display after 5 seconds.

Result Calibration (alignment) of the temperature controller

After the adjustment of the controller the temperature display reading of the reference instrument is compared with the display reading of the controller MB1 again:

Temperature set point of the controller	Actual value shown on the test equipment	Confidence criteria fulfilled	
		Yes	No
_____°C	_____°C	☐	☐

CO_2 calibration (alignment)

Reset of former calibrations

Normal Display ® ***Config*** ® *Configuration 2* ® ***System-Code 2802*** ® ***Service Level*** ® ***Inp. Val. correct.*** ® *Analogue input 4*

Enter the value 0 to *Start Value X.*
Enter the value 0 to *Start Value W.*
Enter the value 1000 to *End Value X.*
Enter the value 1000 to *End Value W.*

Set *State* ***to Off***

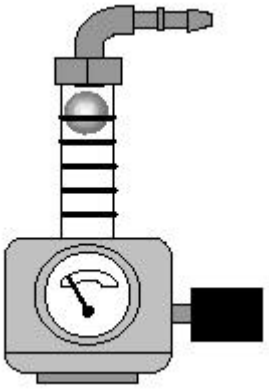
® ***leave menu with 4 x EXIT.***

Determination and entry of the calibration values

The incubator has to be pre-heated at the working temperature (common value 37°C) for at least half an hour. The altitude of the site above the sea level has to be entered to the temperature/CO_2-controller. The procedure is described in chapter 7.3 of the operation manual.

Afterwards the incubator is switched off at the main switch (1) and the CO_2 sensor is pulled out of the incubator. The unit doors can now remain open during the calibration. The white filter of the CO_2 sensor is removed and the original BINDER calibration cap is pushed on the sensor tip. The sensor with the calibration cup is put into the socket of the incubator again and the incubator is switch on at the main switch (1).

The calibration is carried out in two individual steps. At first the sensor is exposed to pure nitrogen and afterwards it is exposed to analysed CO_2 test gas with known CO_2 concentration. The original BINDER one-litre pressure gas bottles (10bar) have to be used. The test gas bottles are connected via the original BINDER pressure reducer with flow meter and a plastic tube with the calibration cup. The flow rate has to be situated between 600 and 900 ml/min. This is equal to the two highest graduations of the flow meter in upright position.



Note: The BINDER service uses larger pressure gas bottles with analysed test gases and an other flow meter. But the procedure remains as described.

After 5 minutes exposing of the sensor to each test gas the CO_2-concentration of the gas is entered to the MB1 controller according to the following description.

Exposion to Nitrogen (0 vol.-% CO_2) for 5 minutes:

Normal Display ® ***Config*** ® *Configuration 2* ® ***System-Code 2802*** ® ***Service Level*** ® ***Inp. Val. correct.*** ® *Analogue input 4*

Enter the display value of the controller (e.g. –0.2 Vol.-%) to *Start Value X.*
Enter the CO_2 concentration of Nitrogen (0 Vol.-%) to *Start Value W.*

® ***leave menu with 4 x EXIT and stop exposure with Nitrogen.***

Exposition to test gas (5 vol.-% CO_2) for 5 minutes:

Normal Display ® ***Config*** ® *Configuration 2* ® ***System-Code 2802*** ® ***Service Level*** ® ***Inp. Val. correct.*** ® *Analogue input 4*

Enter the display value of the controller (e.g. 4.7 Vol.-%) to *End Value X.*
Enter the CO_2 concentration of the CO_2 test gas (5.0 Vol.-%) to *End Value W.*

Set *State* ***to On***

® ***leave menu with 4 x EXIT.***

The corrected value 5 Vol.-% appears on the controller display after 5 seconds. Afterwards the exposure with test gas is stopped.

Result CO_2-Adjustment:	Yes	No
The analysis result of the test gas acc. to the label of the gas bottle is reached.	☐	☐

O_2 calibration (alignment)

Reset of former calibrations

Normal Display ® ***Config*** ® *Configuration 2* ® ***System-Code 2802*** ® ***Service Level*** ® ***Inp. Val. correct.*** ® *Analogue input 5*

Enter the value 0 to *Start Value X.*
Enter the value 0 to *Start Value W.*
Enter the value 1000 to *End Value X.*
Enter the value 1000 to *End Value W.*

Set *State* ***to Off***

® ***leave menu with 4 x EXIT.***

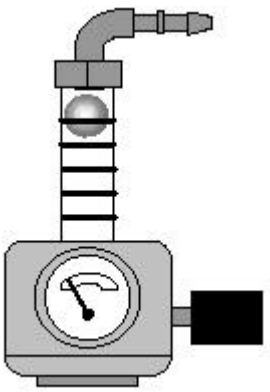
Determination and entry of the calibration values

The incubator has to be pre-heated at the working temperature (common value 37°C) for at least half an hour.

The altitude of the site above the sea level has to be entered to the temperature/ CO_2 /O_2-controller. The procedure is described in chapter 7.3 of the operation manual.

The chamber doors can be opened during the calibration procedure. The original BINDER calibration cap is pushed on the O_2-sensor tip only when exposed to the test gas, not when exposed to ambient air.

The calibration is carried out in two individual steps. At first the sensor is exposed to ambient air and afterwards it is exposed to analysed O_2 test gas with known O_2 concentration. Use the original BINDER one-litre pressure gas bottle (10 bar). The test gas bottle is connected via the original BINDER pressure reducer with flow meter and a plastic tube with the calibration cup. The flow rate has to be situated between 600 and 900 ml/min. This is equal to the two highest graduations of the flow meter in upright position.



Note: The BINDER service uses a larger pressure gas bottle with analysed test gas and an other flow meter. But the procedure remains as described.

After 5 minutes exposing of the sensor to ambient air or to the test gas the entrance signal of the O_2 sensor is corrected according to the table below and is entered to the MB1 controller according to the following description.

Correcting table for O_2- calibration (alignment of controller display)

The connection between the oxygen concentration of the test gas or the ambient air and the expected entrance signal to the MB1 controller is presented in the table below.

O_2 [Vol.-%]	U [mV]		O_2 [Vol.-%]	U [mV]	
20	**198.8**		**79**	**1390.5**	
20.1	**199.9**		**79.1**	**1394.8**	
20.2	**201.1**		**79.2**	**1399.1**	
20.3	**202.2**		**79.3**	**1403.4**	
20.4	**203.3**		**79.4**	**1407.7**	
20.5	**204.4**		**79.5**	**1412.0**	
20.6	**205.5**		**79.6**	**1416.4**	
20.7	**206.7**		**79.7**	**1420.7**	
20.8	**207.8**		**79.8**	**1425.1**	
20.9	**208.9**		**79.9**	**1429.6**	
21	**210.0**	Reference value for air	**80**	**1434.0**	Reference value for BINDER test gas
21.1	**211.2**		**80.1**	**1438.5**	
21.2	**212.3**		**80.2**	**1443.0**	
21.3	**213.4**		**80.3**	**1447.5**	
21.4	**214.6**		**80.4**	**1452.0**	
21.5	**215.7**		**80.5**	**1456.6**	
21.6	**216.8**		**80.6**	**1461.1**	
21.7	**218.0**		**80.7**	**1465.8**	
21.8	**219.1**		**80.8**	**1470.4**	
21.9	**220.2**		**80.9**	**1475.0**	
22	**221.4**		**81**	**1479.7**	
			81.1	**1484.4**	
			81.2	**1489.1**	
			81.3	**1493.9**	
			81.4	**1498.7**	
			81.5	**1503.5**	

If other test gases are used, see table in appendix for according tension values.

The measuring value correcting in the following description is carried out according this table by entering the expected voltage value (W) and the voltage value (X) that corresponds to the actual controller display.

Procedure of O_2- calibration (alignment of controller display)

Sensor without calibration cap, unit door open, unit in normal operation.
Exposition to ambient air (21 vol.-% O_2) for 5 minutes

Comparison of table values:
With ambient air the MB1 controller display shows e.g., 20.3 Vol.-% O2. According to the above table this corresponds to a voltage of 202.2 mV.
With ambient air the MB1 controller display should display 21 Vol.-%. According to the above table this corresponds to a voltage of 210 mV.

Setting:

Normal Display ® ***Config*** ® *Configuration 2* ® ***System-Code 2802*** ® ***Service Level*** ® ***Inp. Val. correct.*** ® *Analogue input 5*

> ***For*** *Start Value X* ***enter the voltage value that corresponds to the controller display (e.g., 202.2).***
> ***For*** *Start Value W* ***enter the reference voltage value of the O_2 concentration of the ambient air (210).***

® ***leave menu with 4 x EXIT.***

Sensor with pushed-on calibration cap, unit door open, unit in normal operation.
Sensor exposition to test gas 80 vol.-% O_2 for 5 minutes:

Comparison of table values:
With sensor exposition to test gas (80 Vol.-% O_2) the MB1 controller display shows e.g., 80.9 Vol.-%. According to the above table this corresponds to a voltage of 1475mV.

With sensor exposition to test gas (80 Vol.-% O_2) the MB1 controller display should display 80 Vol.-%. According to the above table this corresponds to a voltage of 1434mV.

End value setting:

Normal Display ® ***Config*** ® *Configuration 2* ® ***System-Code 2802*** ® ***Service Level*** ® ***Inp. Val. correct.*** ® *Analogue input 5*

> ***For*** *End Value X* ***enter the voltage value that corresponds to the controller display (e.g., 1475).***
> ***For*** *End Value W* ***enter the reference voltage value of the O_2 test gas (80 vol.-%) (1434).***
>
> Set **State** to On

→ leave menu with 4 x EXIT.

The corrected value 80 vol.-% appears on the controller display after 5 seconds.
Afterwards the exposure with test gas is stopped.

Result O_2-Adjustment:	Yes	No
The analysis result of the test gas acc. to the label of the gas bottle is reached.	☐	☐

Appendix : Conversion table VOL.-% O_2 – mV

O2 [Vol.-%]	U [mV]	O2 [Vol.-%]	U [mV]	O2 [Vol.-%]	U [mV]	O2 [Vol.-%]	U [mV]	O2 [Vol.-%]	U [mV]
0	0.0	5	45.7	10	93.9	15	144.8	20	198.8
0.1	0.9	5.1	46.6	10.1	94.9	15.1	145.9	20.1	199.9
0.2	1.8	5.2	47.6	10.2	95.9	15.2	146.9	20.2	201.1
0.3	2.7	5.3	48.5	10.3	96.9	15.3	148.0	20.3	202.2
0.4	3.6	5.4	49.5	10.4	97.8	15.4	149.0	20.4	203.3
0.5	4.5	5.5	50.4	10.5	98.8	15.5	150.1	20.5	204.4
0.6	5.4	5.6	51.3	10.6	99.8	15.6	151.1	20.6	205.5
0.7	6.3	5.7	52.3	10.7	100.8	15.7	152.2	20.7	206.7
0.8	7.2	5.8	53.2	10.8	101.8	15.8	153.2	20.8	207.8
0.9	8.1	5.9	54.2	10.9	102.8	15.9	154.3	20.9	208.9
1	9.0	6	55.1	11	103.8	16	155.3	21	210.0
1.1	9.9	6.1	56.1	11.1	104.8	16.1	156.4	21.1	211.2
1.2	10.8	6.2	57.0	11.2	105.8	16.2	157.5	21.2	212.3
1.3	11.7	6.3	58.0	11.3	106.8	16.3	158.5	21.3	213.4
1.4	12.6	6.4	58.9	11.4	107.8	16.4	159.6	21.4	214.6
1.5	13.5	6.5	59.9	11.5	108.9	16.5	160.7	21.5	215.7
1.6	14.4	6.6	60.8	11.6	109.9	16.6	161.7	21.6	216.8
1.7	15.3	6.7	61.8	11.7	110.9	16.7	162.8	21.7	218.0
1.8	16.2	6.8	62.7	11.8	111.9	16.8	163.9	21.8	219.1
1.9	17.1	6.9	63.7	11.9	112.9	16.9	164.9	21.9	220.2
2	18.0	7	64.7	12	113.9	17	166.0	22	221.4
2.1	18.9	7.1	65.6	12.1	114.9	17.1	167.1	22.1	222.5
2.2	19.8	7.2	66.6	12.2	115.9	17.2	168.2	22.2	223.7
2.3	20.7	7.3	67.5	12.3	116.9	17.3	169.2	22.3	224.8
2.4	21.6	7.4	68.5	12.4	118.0	17.4	170.3	22.4	226.0
2.5	22.6	7.5	69.5	12.5	119.0	17.5	171.4	22.5	227.1
2.6	23.5	7.6	70.4	12.6	120.0	17.6	172.5	22.6	228.3
2.7	24.4	7.7	71.4	12.7	121.0	17.7	173.6	22.7	229.4
2.8	25.3	7.8	72.4	12.8	122.0	17.8	174.6	22.8	230.6
2.9	26.2	7.9	73.3	12.9	123.1	17.9	175.7	22.9	231.7
3	27.1	8	74.3	13	124.1	18	176.8	23	232.9
3.1	28.1	8.1	75.3	13.1	125.1	18.1	177.9	23.1	234.0
3.2	29.0	8.2	76.2	13.2	126.1	18.2	179.0	23.2	235.2
3.3	29.9	8.3	77.2	13.3	127.2	18.3	180.1	23.3	236.4
3.4	30.8	8.4	78.2	13.4	128.2	18.4	181.2	23.4	237.5
3.5	31.7	8.5	79.1	13.5	129.2	18.5	182.3	23.5	238.7
3.6	32.7	8.6	80.1	13.6	130.2	18.6	183.4	23.6	239.8
3.7	33.6	8.7	81.1	13.7	131.3	18.7	184.5	23.7	241.0
3.8	34.5	8.8	82.1	13.8	132.3	18.8	185.6	23.8	242.2
3.9	35.4	8.9	83.1	13.9	133.3	18.9	186.7	23.9	243.4
4	36.4	9	84.0	14	134.4	19	187.8	24	244.5
4.1	37.3	9.1	85.0	14.1	135.4	19.1	188.9	24.1	245.7
4.2	38.2	9.2	86.0	14.2	136.5	19.2	190.0	24.2	246.9
4.3	39.2	9.3	87.0	14.3	137.5	19.3	191.1	24.3	248.0
4.4	40.1	9.4	88.0	14.4	138.5	19.4	192.2	24.4	249.2
4.5	41.0	9.5	88.9	14.5	139.6	19.5	193.3	24.5	250.4
4.6	42.0	9.6	89.9	14.6	140.6	19.6	194.4	24.6	251.6
4.7	42.9	9.7	90.9	14.7	141.7	19.7	195.5	24.7	252.8
4.8	43.8	9.8	91.9	14.8	142.7	19.8	196.6	24.8	254.0
4.9	44.8	9.9	92.9	14.9	143.8	19.9	197.7	24.9	255.1

O2 [Vol.-%]	U [mV]	O2 [Vol.-%]	U [mV]	O2 [Vol.-%]	U [mV]	O2 [Vol.-%]	U [mV]	O2 [Vol.-%]	U [mV]
25	256.3	30	317.8	35	383.8	40	455.1	45	532.7
25.1	257.5	30.1	319.1	35.1	385.2	40.1	456.6	45.1	534.3
25.2	258.7	30.2	320.3	35.2	386.6	40.2	458.1	45.2	535.9
25.3	259.9	30.3	321.6	35.3	387.9	40.3	459.6	45.3	537.5
25.4	261.1	30.4	322.9	35.4	389.3	40.4	461.1	45.4	539.2
25.5	262.3	30.5	324.2	35.5	390.7	40.5	462.6	45.5	540.8
25.6	263.5	30.6	325.5	35.6	392.1	40.6	464.1	45.6	542.4
25.7	264.7	30.7	326.8	35.7	393.5	40.7	465.6	45.7	544.1
25.8	265.9	30.8	328.0	35.8	394.9	40.8	467.1	45.8	545.7
25.9	267.1	30.9	329.3	35.9	396.3	40.9	468.6	45.9	547.4
26	268.3	31	330.6	36	397.6	41	470.1	46	549.0
26.1	269.5	31.1	331.9	36.1	399.0	41.1	471.6	46.1	550.7
26.2	270.7	31.2	333.2	36.2	400.4	41.2	473.1	46.2	552.3
26.3	271.9	31.3	334.5	36.3	401.8	41.3	474.7	46.3	554.0
26.4	273.1	31.4	335.8	36.4	403.2	41.4	476.2	46.4	555.6
26.5	274.3	31.5	337.1	36.5	404.6	41.5	477.7	46.5	557.3
26.6	275.5	31.6	338.4	36.6	406.0	41.6	479.2	46.6	559.0
26.7	276.8	31.7	339.7	36.7	407.4	41.7	480.8	46.7	560.6
26.8	278.0	31.8	341.0	36.8	408.8	41.8	482.3	46.8	562.3
26.9	279.2	31.9	342.3	36.9	410.3	41.9	483.8	46.9	564.0
27	280.4	32	343.6	37	411.7	42	485.4	47	565.7
27.1	281.6	32.1	344.9	37.1	413.1	42.1	486.9	47.1	567.4
27.2	282.9	32.2	346.2	37.2	414.5	42.2	488.4	47.2	569.0
27.3	284.1	32.3	347.6	37.3	415.9	42.3	490.0	47.3	570.7
27.4	285.3	32.4	348.9	37.4	417.3	42.4	491.5	47.4	572.4
27.5	286.5	32.5	350.2	37.5	418.8	42.5	493.1	47.5	574.1
27.6	287.8	32.6	351.5	37.6	420.2	42.6	494.6	47.6	575.8
27.7	289.0	32.7	352.8	37.7	421.6	42.7	496.2	47.7	577.5
27.8	290.2	32.8	354.2	37.8	423.1	42.8	497.7	47.8	579.2
27.9	291.5	32.9	355.5	37.9	424.5	42.9	499.3	47.9	580.9
28	292.7	33	356.8	38	425.9	43	500.8	48	582.6
28.1	293.9	33.1	358.2	38.1	427.4	43.1	502.4	48.1	584.4
28.2	295.2	33.2	359.5	38.2	428.8	43.2	504.0	48.2	586.1
28.3	296.4	33.3	360.8	38.3	430.3	43.3	505.5	48.3	587.8
28.4	297.7	33.4	362.2	38.4	431.7	43.4	507.1	48.4	589.5
28.5	298.9	33.5	363.5	38.5	433.1	43.5	508.7	48.5	591.3
28.6	300.2	33.6	364.8	38.6	434.6	43.6	510.3	48.6	593.0
28.7	301.4	33.7	366.2	38.7	436.0	43.7	511.9	48.7	594.7
28.8	302.7	33.8	367.5	38.8	437.5	43.8	513.4	48.8	596.5
28.9	303.9	33.9	368.9	38.9	439.0	43.9	515.0	48.9	598.2
29	305.2	34	370.2	39	440.4	44	516.6	49	599.9
29.1	306.4	34.1	371.6	39.1	441.9	44.1	518.2	49.1	601.7
29.2	307.7	34.2	372.9	39.2	443.3	44.2	519.8	49.2	603.5
29.3	308.9	34.3	374.3	39.3	444.8	44.3	521.4	49.3	605.2
29.4	310.2	34.4	375.6	39.4	446.3	44.4	523.0	49.4	607.0
29.5	311.5	34.5	377.0	39.5	447.8	44.5	524.6	49.5	608.7
29.6	312.7	34.6	378.4	39.6	449.2	44.6	526.2	49.6	610.5
29.7	314.0	34.7	379.7	39.7	450.7	44.7	527.8	49.7	612.3
29.8	315.3	34.8	381.1	39.8	452.2	44.8	529.4	49.8	614.0
29.9	316.5	34.9	382.5	39.9	453.7	44.9	531.1	49.9	615.8

O2 [Vol.-%]	U [mV]	O2 [Vol.-%]	U [mV]	O2 [Vol.-%]	U [mV]	O2 [Vol.-%]	U [mV]	O2 [Vol.-%]	U [mV]
50	617.6	55	711.5	60	816.4	65	935.4	70	1072.7
50.1	619.4	55.1	713.5	60.1	818.6	65.1	937.9	70.1	1075.7
50.2	621.2	55.2	715.4	60.2	820.9	65.2	940.5	70.2	1078.7
50.3	623.0	55.3	717.4	60.3	823.1	65.3	943.1	70.3	1081.7
50.4	624.8	55.4	719.4	60.4	825.4	65.4	945.6	70.4	1084.7
50.5	626.5	55.5	721.4	60.5	827.6	65.5	948.2	70.5	1087.7
50.6	628.4	55.6	723.4	60.6	829.9	65.6	950.8	70.6	1090.7
50.7	630.2	55.7	725.4	60.7	832.1	65.7	953.4	70.7	1093.8
50.8	632.0	55.8	727.5	60.8	834.4	65.8	956.0	70.8	1096.8
50.9	633.8	55.9	729.5	60.9	836.7	65.9	958.6	70.9	1099.9
51	635.6	56	731.5	61	839.0	66	961.2	71	1102.9
51.1	637.4	56.1	733.5	61.1	841.3	66.1	963.8	71.1	1106.0
51.2	639.2	56.2	735.6	61.2	843.6	66.2	966.5	71.2	1109.1
51.3	641.1	56.3	737.6	61.3	845.9	66.3	969.1	71.3	1112.2
51.4	642.9	56.4	739.6	61.4	848.2	66.4	971.8	71.4	1115.3
51.5	644.7	56.5	741.7	61.5	850.5	66.5	974.4	71.5	1118.4
51.6	646.6	56.6	743.7	61.6	852.8	66.6	977.1	71.6	1121.6
51.7	648.4	56.7	745.8	61.7	855.1	66.7	979.8	71.7	1124.7
51.8	650.3	56.8	747.8	61.8	857.4	66.8	982.4	71.8	1127.9
51.9	652.1	56.9	749.9	61.9	859.8	66.9	985.1	71.9	1131.0
52	654.0	57	752.0	62	862.1	67	987.8	72	1134.2
52.1	655.8	57.1	754.1	62.1	864.5	67.1	990.5	72.1	1137.4
52.2	657.7	57.2	756.1	62.2	866.8	67.2	993.2	72.2	1140.6
52.3	659.6	57.3	758.2	62.3	869.2	67.3	996.0	72.3	1143.8
52.4	661.4	57.4	760.3	62.4	871.5	67.4	998.7	72.4	1147.0
52.5	663.3	57.5	762.4	62.5	873.9	67.5	1001.4	72.5	1150.3
52.6	665.2	57.6	764.5	62.6	876.3	67.6	1004.2	72.6	1153.5
52.7	667.1	57.7	766.6	62.7	878.7	67.7	1006.9	72.7	1156.8
52.8	668.9	57.8	768.7	62.8	881.1	67.8	1009.7	72.8	1160.0
52.9	670.8	57.9	770.8	62.9	883.5	67.9	1012.5	72.9	1163.3
53	672.7	58	772.9	63	885.9	68	1015.2	73	1166.6
53.1	674.6	58.1	775.1	63.1	888.3	68.1	1018.0	73.1	1169.9
53.2	676.5	58.2	777.2	63.2	890.7	68.2	1020.8	73.2	1173.2
53.3	678.4	58.3	779.3	63.3	893.1	68.3	1023.6	73.3	1176.6
53.4	680.3	58.4	781.5	63.4	895.6	68.4	1026.4	73.4	1179.9
53.5	682.3	58.5	783.6	63.5	898.0	68.5	1029.3	73.5	1183.3
53.6	684.2	58.6	785.8	63.6	900.4	68.6	1032.1	73.6	1186.6
53.7	686.1	58.7	787.9	63.7	902.9	68.7	1034.9	73.7	1190.0
53.8	688.0	58.8	790.1	63.8	905.4	68.8	1037.8	73.8	1193.4
53.9	690.0	58.9	792.2	63.9	907.8	68.9	1040.7	73.9	1196.8
54	691.9	59	794.4	64	910.3	69	1043.5	74	1200.2
54.1	693.8	59.1	796.6	64.1	912.8	69.1	1046.4	74.1	1203.7
54.2	695.8	59.2	798.8	64.2	915.3	69.2	1049.3	74.2	1207.1
54.3	697.7	59.3	801.0	64.3	917.7	69.3	1052.2	74.3	1210.6
54.4	699.7	59.4	803.1	64.4	920.2	69.4	1055.1	74.4	1214.1
54.5	701.6	59.5	805.3	64.5	922.8	69.5	1058.0	74.5	1217.5
54.6	703.6	59.6	807.5	64.6	925.3	69.6	1060.9	74.6	1221.0
54.7	705.6	59.7	809.8	64.7	927.8	69.7	1063.9	74.7	1224.6
54.8	707.5	59.8	812.0	64.8	930.3	69.8	1066.8	74.8	1228.1
54.9	709.5	59.9	814.2	64.9	932.8	69.9	1069.8	74.9	1231.6

O2 [Vol.-%]	U [mV]	O2 [Vol.-%]	U [mV]	O2 [Vol.-%]	U [mV]	O2 [Vol.-%]	U [mV]	O2 [Vol.-%]	U [mV]
75	1235.2	80	1434.0	85	1690.3	90	2051.6	95	2669.2
75.1	1238.8	80.1	1438.5	85.1	1696.3	90.1	2060.6	95.1	2687.2
75.2	1242.3	80.2	1443.0	85.2	1702.3	90.2	2069.6	95.2	2705.6
75.3	1245.9	80.3	1447.5	85.3	1708.3	90.3	2078.7	95.3	2724.3
75.4	1249.6	80.4	1452.0	85.4	1714.4	90.4	2088.0	95.4	2743.5
75.5	1253.2	80.5	1456.6	85.5	1720.5	90.5	2097.3	95.5	2763.1
75.6	1256.8	80.6	1461.1	85.6	1726.7	90.6	2106.7	95.6	2783.1
75.7	1260.5	80.7	1465.8	85.7	1732.9	90.7	2116.3	95.7	2803.6
75.8	1264.2	80.8	1470.4	85.8	1739.2	90.8	2125.9	95.8	2824.5
75.9	1267.9	80.9	1475.0	85.9	1745.5	90.9	2135.6	95.9	2846.0
76	1271.6	81	1479.7	86	1751.8	91	2145.5	96	2868.0
76.1	1275.3	81.1	1484.4	86.1	1758.2	91.1	2155.4	96.1	2890.6
76.2	1279.0	81.2	1489.1	86.2	1764.6	91.2	2165.5	96.2	2913.7
76.3	1282.8	81.3	1493.9	86.3	1771.1	91.3	2175.7	96.3	2937.5
76.4	1286.5	81.4	1498.7	86.4	1777.6	91.4	2186.0	96.4	2961.9
76.5	1290.3	81.5	1503.5	86.5	1784.2	91.5	2196.4	96.5	2987.0
76.6	1294.1	81.6	1508.3	86.6	1790.8	91.6	2207.0	96.6	3012.8
76.7	1297.9	81.7	1513.2	86.7	1797.5	91.7	2217.6	96.7	3039.4
76.8	1301.8	81.8	1518.0	86.8	1804.2	91.8	2228.4	96.8	3066.8
76.9	1305.6	81.9	1522.9	86.9	1811.0	91.9	2239.4	96.9	3095.1
77	1309.5	82	1527.9	87	1817.8	92	2250.4	97	3124.3
77.1	1313.4	82.1	1532.8	87.1	1824.7	92.1	2261.6	97.1	3154.5
77.2	1317.3	82.2	1537.8	87.2	1831.7	92.2	2273.0	97.2	3185.8
77.3	1321.2	82.3	1542.9	87.3	1838.6	92.3	2284.5	97.3	3218.2
77.4	1325.1	82.4	1547.9	87.4	1845.7	92.4	2296.1	97.4	3251.8
77.5	1329.1	82.5	1553.0	87.5	1852.8	92.5	2307.9	97.5	3286.8
77.6	1333.0	82.6	1558.1	87.6	1859.9	92.6	2319.9	97.6	3323.2
77.7	1337.0	82.7	1563.2	87.7	1867.2	92.7	2332.0	97.7	3361.1
77.8	1341.0	82.8	1568.4	87.8	1874.4	92.8	2344.3	97.8	3400.7
77.9	1345.0	82.9	1573.6	87.9	1881.8	92.9	2356.8	97.9	3442.1
78	1349.1	83	1578.8	88	1889.2	93	2369.4	98	3485.6
78.1	1353.1	83.1	1584.1	88.1	1896.6	93.1	2382.2	98.1	3531.3
78.2	1357.2	83.2	1589.4	88.2	1904.1	93.2	2395.2	98.2	3579.5
78.3	1361.3	83.3	1594.7	88.3	1911.7	93.3	2408.4	98.3	3630.4
78.4	1365.4	83.4	1600.0	88.4	1919.4	93.4	2421.8	98.4	3684.4
78.5	1369.6	83.5	1605.4	88.5	1927.1	93.5	2435.4	98.5	3741.9
78.6	1373.7	83.6	1610.8	88.6	1934.9	93.6	2449.2	98.6	3803.4
78.7	1377.9	83.7	1616.3	88.7	1942.7	93.7	2463.3	98.7	3869.4
78.8	1382.1	83.8	1621.8	88.8	1950.6	93.8	2477.5	98.8	3940.8
78.9	1386.3	83.9	1627.3	88.9	1958.6	93.9	2492.0	98.9	4018.3
79	1390.5	84	1632.8	89	1966.7	94	2506.7	99	4103.2
79.1	1394.8	84.1	1638.4	89.1	1974.8	94.1	2521.7	99.1	4197.1
79.2	1399.1	84.2	1644.0	89.2	1983.0	94.2	2537.0	99.2	4302.0
79.3	1403.4	84.3	1649.7	89.3	1991.3	94.3	2552.5	99.3	4421.0
79.4	1407.7	84.4	1655.4	89.4	1999.7	94.4	2568.2	99.4	4558.4
79.5	1412.0	84.5	1661.1	89.5	2008.1	94.5	2584.3	99.5	4720.8
79.6	1416.4	84.6	1666.9	89.6	2016.7	94.6	2600.6	99.6	4919.6
79.7	1420.7	84.7	1672.7	89.7	2025.3	94.7	2617.3	99.7	5175.9
79.8	1425.1	84.8	1678.5	89.8	2034.0	94.8	2634.3	99.8	5537.2
79.9	1429.6	84.9	1684.4	89.9	2042.7	94.9	2651.6	99.9	6154.8
								100	30157.2

7 Maintenance

The BINDER GmbH determines a annual service period to ensure the high quality and reproducibility of the results elaborated by help of this incubator.

Following tests and maintenance works must be carried out for a comprehensive maintenance.

1	After the door has been open for 30 sec. the temperature (target 37°C) and the CO_2 content (target 5%) must have recovered to 98% of their set value after 10 min..
2	A visual check is performed of the chamber for general condition, wear and corrosion.
3	The doors are checked for serviceability, corrosion, functionality and condition. The door sealing are examined for wear, seat and damage.
4	The serviceability and functionality of the hinges are tested.
5	The closing mechanism is checked for serviceability and functionality.
6	The seal of the glass doors is checked. The glass doors are examined for damage.
7	The temperature controller MB1 is operated, set values input and all keys checked for functionality.
8	The safety device 3.1 is tested for functionality. (set temp lower at safety device 3.1)
9	The CO_2 controller is operated, set values input and all keys checked for functionality. The CO_2 cut-off via the door contact is tested for functionality.
10	The warning lamp is tested.
11	The latest control parameters are tested and input where necessary.
12	The steri filter is checked for contamination and replaced if necessary.
13	The FPI-sensor head is subjected to a visual inspection.
14	The Permadry® water basin is checked for level, tightness, evenness and deposits.
15	The power consumption of the door and chamber heating elements are measured.
16	A complete visual inspection of the gas system is performed.
17	The functionality of the magnetic valves is checked.
18	The pressure switch is checked for functionality.
19	The sterilization function is checked.
20	A visual inspection of the relays is performed.
21	The main fan is checked for functionality.
22	The Permadry® fan is checked for functionality.
23	The availability of the operating manual (e.g. for safety information) is checked.
24	The VDE test including determination of leakage current and insulation resistance is performed (for Germany – other safety standards may be considered in other countries)
25	The temperature is re-calibrated.
26	The CO_2 is re-calibrated.

Following service report should filled out during every maintenance and a copy should be handed over to the customer.

Maintenance schedule CO_2 Incubators series CB

Type: CB					b i n BEST CONDITIONS FOR YOUR SUCCESS Service Station	
Serial number:						
Working hour:						
Calibration:		Yes		No		
Contract Number:					Type Number:	
Working step	**Component**					**Remark**
01	recovery time CO_2 and Temperature					
02	general condition					
03	door, door sealing					
04	Hinges					
05	Closing mechanism					
06	glass door, closer and sealing					
07	Temperature controller					
08	safety class 3.3					
09	CO_2 controller, door switch					
10	Alarm lights					
11	Parameter ”update”					
12	Steri-filter					
13	FPI sensor check					
	Interior of the oven					
14	Permadry-water basin					
15	Power consumption heating elements					
	In the H-box					
16	Visual check CO_2 tubing					
17	Solenoid valve					
18	Pressure switch					
19	Sterilization					
20	Relay					
21	Main fan					
22	Permadry® fan					
	Rear side of the unit					
23	Operating manual					
24	Electrical security test					
25	Temperature calibration					
26	CO_2 calibration					
Implementation features:						
Maintenance issued by:		Date:			signature :	
Customer confirmation		Date			signature :	
Calibration certification handed over:		Date:			signature :	

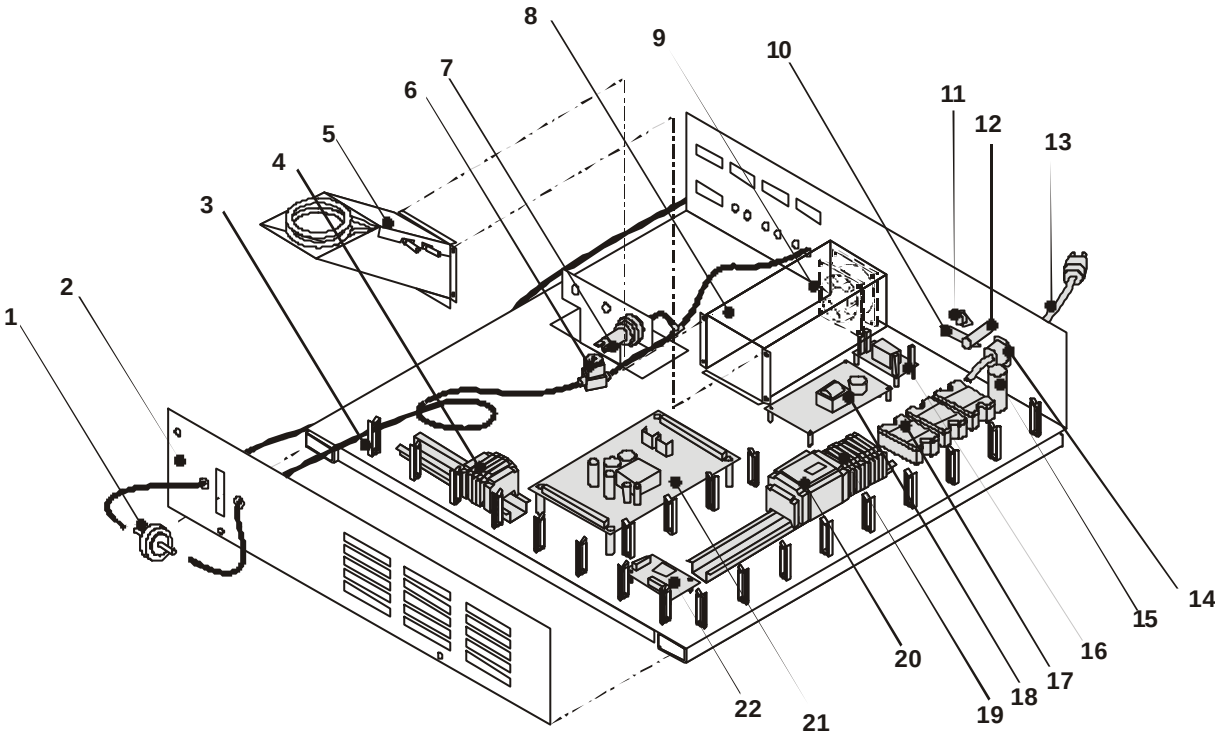
Explanation to the maintenance schedule CO_2 incubators series CB

Working step	Working instruction	Supplement
01	Function	
02	general state (optical test), wear, corrosion	
03	wear, corrosion, compactness, function, state	
04	wear, corrosion, function	
05	wear, corrosion, adjust	
06	function, adjust	
07	Function	
08	Function	
09	Function	
10	Function	
11	Function	
12	adjust	
13	check, exchange	
14	Function	
15	function	
16	filling level, all proportions, compactness, sediments	
17	Function	
18	Function	
19	function	
20	Function	
21	Function	
22	Function	
23	Function	
24	Function	
25	available ?	
26	Leakage current, insulation resistance	
27	adjust temperature, 1 point measurement with one value	
28	adjust CO_2 and O_2, CO_2-adjustment: zero and one value (5% CO_2 test gas) O_2-adjustment: one measurement value	

Symbol	Meaning
X	Defects
OK	without error
/	not existence

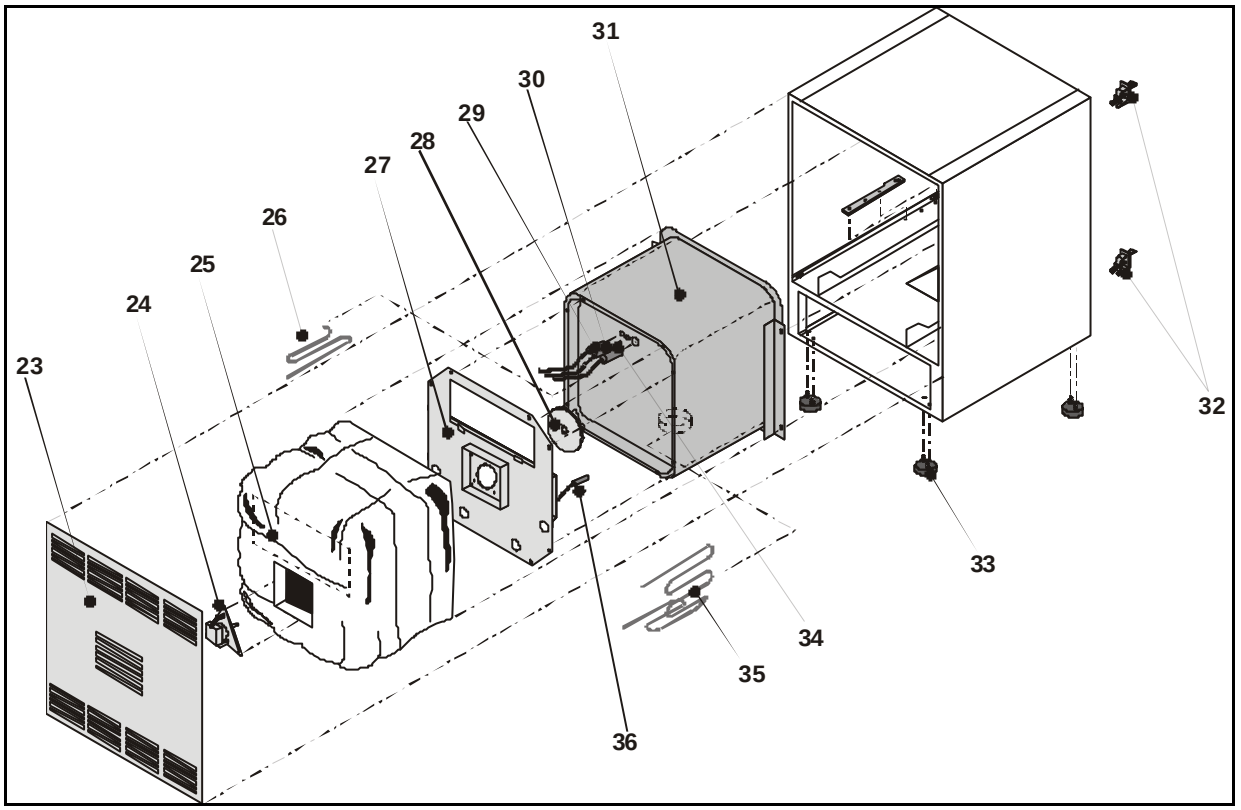
8 Explosion Drawings of the CB /E2

8.1 CB Component Board



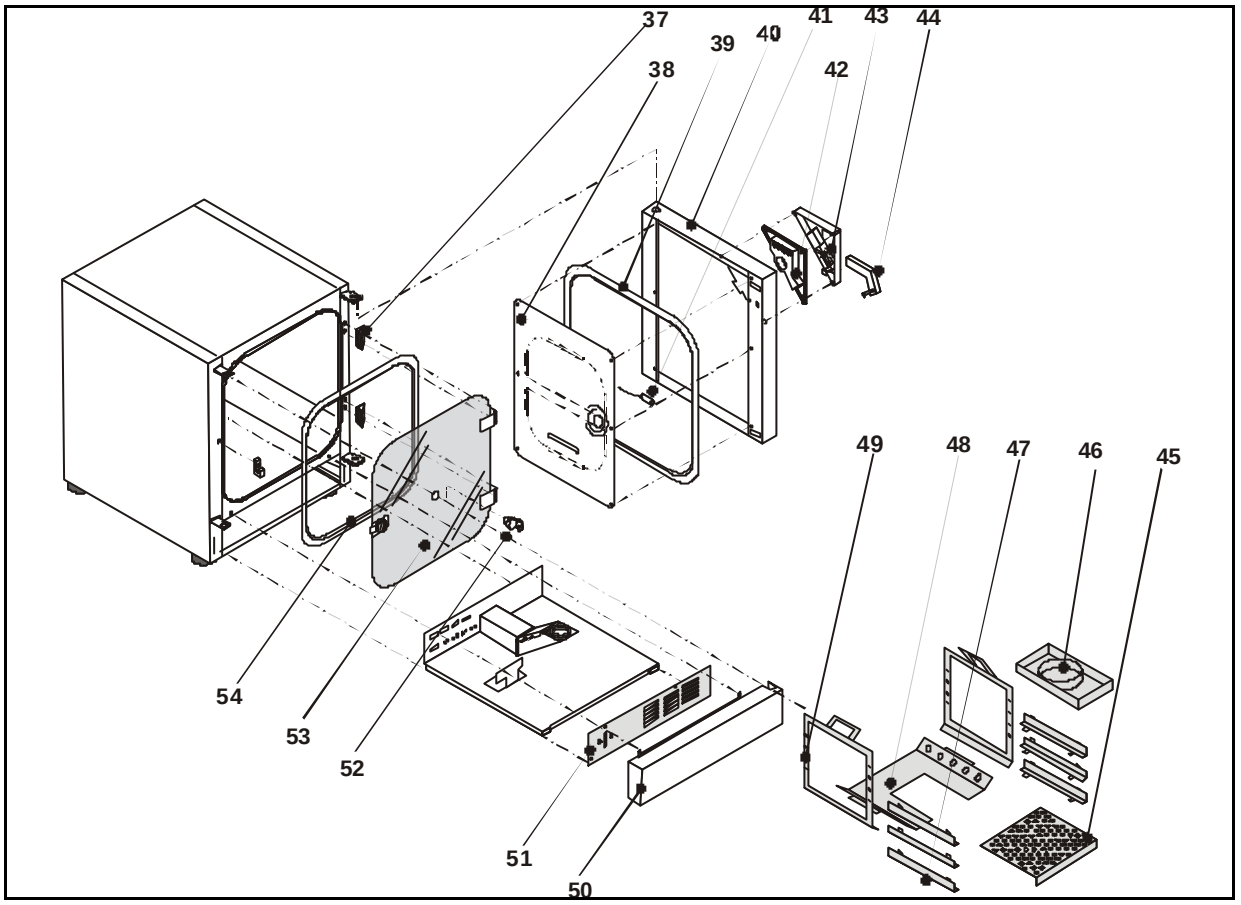
Number	Description	Article-No.
1	Gas fine filter	6014-0009
2	Cover Front Access Module	4022-0054 (CB 150) 4022-0077 (CB 210)
3	Mounting panel	4007-0074
4	Pass clamp (grey)	5024-0020
5	Permadry®	By request
6	Solenoid Valve	5025-0013
7	Pressure Switch 0,8bar	5006-0034
8	Permadry®-Housing Part 1	By request
9	Permadry® Fan	5013-0009
10	RS422 Interface	5023-0050
11	Cable 3-wire to Plug 6-pole	5023-0075
12	Fuse-Holder + Fuse	5006-0038 / 5006-0012
13	Power Supply Cable	5023-0002
14	Power supply cable protection	6002-0004
15	Single Phase Filter	5026-0001
16	Power supplies (O_2-Sensor Board)	5020-0015
17	Solid State Relay	5011-0031
18	O_2 – Controller Board(Option)	5020-0015
19	Cable holder	6002-0042
20	M-Tron Module (Option N_2 / O_2 Control)	5014-0070 (M-Tron 4010) 5014-0071 (M-Tron 4030)
21	Controller MB1 Board	5014-0060
22	FPI-Sensor Board	5014-0063

8.2 CB Kettle / Sensors / Heaters / Permadry



Number	Description	Article-No.
23	Rear-Wall	4001-0285
24	Main Fan (Motor-Part)	5013-0005 (with Part 28)
25	Insulation Kettle	Not available as single part
26	Heating Element (115V / 550W) right	5005-0075
27	Inner Rear Part	Not available as single part
28	Main Fan (Wheel-Part)	5013-0005 (with Part 24)
29	FPI Sensor Head	5002-0023
30	Gas mixing head	6009-0036
31	Kettle CB	Available in arrangement
32	Door lock system	6006-0003 / 6006-0034
33	Adjustable Foot	6002-0082 / 6002-0083
34	Double-Pt100 Temperature Probe	5002-0009
35	Heating Element (115V / 550W) left	5005-0076
36	Pt100 temperature probe (heating Element)	5002-0021

8.3 CB Door / Sealing / Inner parts



Number	Description	Article-No.
37	Hinge Glass Door	Is mounted on Glass Door
38	Inner Part (CB Door)	By request
39	Outer door sealing	6005-0017 (CB 150) 6005-0080 (CB 210)
40	Outer Part (CB Door) varnishes	By request
41	Pt100 temperature probe (Door)	5014-0021
42	MB1 Display-Board	5014-0059
43	Triangle-Cover	6002-0180
44	Door Handle	6002-0121
45	Shelf	6004-0018 (CB 150) 6004-0019 (CB 210)
46	Water Basins (Permadry®)	4022-0081
47	Shelf holder	4021-0050 (CB 150 & CB 210)
48	Shelf Holder Rack bottom	4005-0093 (CB 150) 4005-0094 (CB 210)
49	Shelf Holder Rack side part	4005-0092 (CB 150) 4005-0095 (CB 210)
50	Housing Cover	4001-0286 (CB 150) 4001-0329 (CB 210)
51	Cover Front Access Module	4022-0054 (CB 150) 4022-0077 (CB 210)
52	Glass door plug	6002-0060
53	Glass door	8010-0019 (CB 150) 8010-0020 (CB 210)
54	Glass door sealing	6005-0077 (CB 150) 6005-0080 (CB 210)